ANNALS
OF
The Entomological Society of America

Volume XI JUNE, 1918 Number 2

THE COMPARATIVE MORPHOLOGY OF THE GENITALIA OF INSECTS.*

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I. INTRODUCTION.
  1. Somites.
  2. Theories and Investigators.
  3. Posterior Somites.
  4. Genitalia.
  5. Cerci.
  6. Acknowledgments.
II. INVESTIGATION.
  1. General Principles.
  2. Method of Preparation.
  3. Discussion and Tables:
    a. Thysanura.
    b. Orthoptera.
    c. Hemiptera.
    d. Neuroptera.
    e. Mecoptèra.
    f. Trichoptera.
    g. Coleoptera.
    h. Lepidoptera.
    i. Diptera.
    j. Hymenoptera.
III. SUMMARY.
  1. Somite Eight.
  2. Somite Nine.
  3. Somite Ten.
  4. Somite Eleven.
  5. General Statement.
  6. Appendage I.
  7. Appendages II and III.
  8. Appendage IV.
IV. BIBLIOGRAPHY.
V. EXPLANATION OF PLATES.
VI. PLATES.

I. INTRODUCTION.

1. SOMITES.—The third and caudal region of those into which an insect is divided is called the abdomen. Here, for the most part, the segments of which it is composed show a simple and almost primitive structure. In the adult a typical segment, more properly designated a somite, consists of a dorsal chitinized portion or sclerite, called the tergum, and a ventral sclerite, or sternum. These are connected laterally by arthrodial membranes, conjunctiva or pleura, in each one of which is a spiracle. There are exceptions to this arrangement at both cephalic and caudal ends, with the greater complexity at the latter. No

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* Contribution from the Entomological Laboratories of the University of Illinois, No. 51.

spiracles are ever present caudad of the eighth somite, and, in most cases, where the somites caudad of the seventh are retracted, spiracles are lacking in the eighth. Therefore it is evident that the adult abdomen always presents, to the eye at least, a far more simple composition than do the head and thorax. In reality, in many larvæ an abdominal somite is an entire ring without differentiation into tergite or sternite, an arrangement often seen in the lower thoracic somites, and a more nearly primitive one than that above mentioned.

The general shape of the abdomen, taken as a whole, also varies considerably. According to the best authorities, one ought to recognize the abdomen, systematically, from the number of its somites and from its appendages. The fact suggested above, that the caudal somites may be more or less, even entirely, concealed by retraction, is responsible for the numbering of abdominal somites which is based only upon the number of visible somites and has no justification in morphology. Disagreement upon this point is found, however, not only among the systematists, who formerly limited themselves to numbering the abdominal somites which were undoubtedly visible, but also among the morphologists. The latter differ in their results for various reasons, as follows: (1) Because of the loss of certain sclerites. (2) Because of differences in the point of view: *e. g.*, some investigators begin to count at the cephalic, while others begin at the caudal end of the abdomen, and still others do not correlate closely dorsal and ventral sclerites. (3) Because, undoubtedly, of failure to observe the sclerites present in the caudal region, due in many cases to the lack of potash or other suitable reagents and methods for exposing chitinized parts.

2. THEORIES AND INVESTIGATORS.—There follows at this point a list of prominent investigators together with the number of abdominal somites which they have believed were present in the adults of certain orders:

ORTHOPTERA.

1872	Chadima	11 abdominal somites
1876	Brunner von Wattenwyl	9 abdominal somites
1882	Tarzioni-Tozzetti	11 abdominal somites

COLEOPTERA.

1894	Peytoureau (in Hydrophilus)	8 abdominal somites
1894	Peytoureau (in Dytiscus)	9 abdominal somites
1893	Kolbe (in lamellicornia)	9 abdominal somites
1893	1894 1896 Verhoeff	10 abdominal somites
1903	Berlese (in Coleoptera in general)	11 abdominal somites

HEMIPTERA.

1893 1894 1896	Verhoeff	11 abdominal somites

LEPIDOPTERA.

1832	Burmeister	9 abdominal somites
1893	Kolbe	9 abdominal somites
1894	Peytoureau	10 abdominal somites
1903	Berlese	At least 10 abdominal somites

TRICHOPTERA.

1849-53	Lacaze-Duthiers, typical number in insects	11 abdominal somites
1886 1888	Grassi, typical number in insects	10 abdominal somites
1901	Zander	13 abdominal somites

From investigations on Thysanura, according to Grassi, there are 10 abdominal somites besides "ein Afterstück, das allerdings nicht mehr als Segment aufzufassen ist;" according to C. Brunner von Wattenwyl, this is a terminal segment, welches aus den drei Afterklappen und den seitlich inserirten "Anhängseln (Cerci) gebildet wird."

Berlese concludes his discussion of the matter by saying that the entire number of abdominal somites varies from nine to eleven, except for the Collembola, which he considered aberrant, this reduction taking place from the lower to the higher orders, and at the caudal as well as at the cephalic end of the abdomen. He states emphatically that eleven is not exceeded, aside from the telson with its rudiments, found only in certain of the Thysanura and immature Orthoptera, and he therefore would consider eleven as the typical number.

Certain other investigators, represented mainly by Heymons, uphold the view that the primitive number of abdominal segments is twelve; the twelfth, just as much as the eleven cephalad of it, containing a cœlomatic cavity. Heymons calls this twelfth somite the telson, and his evidence for it is found mainly in certain Thysanura, where he identifies it with a small sclerite, called by many the supra-anal plate, situated between the eleventh tergite and the anus. He also describes it in immature Acrididæ, Locustidæ, and Gryllidæ as a triangular plate separated from the eleventh tergite, to which it forms the apex, by a suture. In the adults of some Acrididæ this plate becomes totally fused with the eleventh tergite. In this case the terminal segment is commonly called the eleventh only, instead of the eleventh and twelfth, according to Heymons. Berlese gives another example of the twelfth tergite in *Acrida turrita L.*, a form not studied by Heymons. (Plate VI, Figs. 1, 10, 13, and 17 t 12.)

According to Haase, the eleventh is not an autonomous somite, and Verhœff agrees with him. Dewitz states that the eleventh somite is formed only by the doubling of the tenth, and he says that in Decticus this only occurs after hatching. Wheeler shows and labels eleven segments in all the figures in his well known embryological investigations.

3. POSTERIOR SOMITES.—The first traces of segmentation are found very early in the germ-band of the insect, which becomes divided by transverse grooves into somites. This process, Heider maintains, even precedes gastrulation in Hydrophilus. This is not a primitive condition however. In the completely segmented germ-band, Korschelt and Heider state, there are ten abdominal somites in addition to the telson, and they give the following observations on the germ-bands of various forms, in proof of this statement: Heider, on the germ-band of Hydrophilus; Graber, on Lina, Stenobothrus, various Lepidoptera and Hylotoma; Wheeler, on Doryphora and Blatta; Cholodkovsky, on Blatta; and Carrière on Chalicodoma.

In looking over the plates belonging to all the articles referred to by Korschelt and Heider, in each of the above cases, one sees that in the large number of germ-bands figured the terminal abdominal somite is always numbered eleven, and that in no case is the term telson used, that being the name given by Heymons to the twelfth abdominal somite. Of course, morphologically, what these somites are labeled may seem immaterial, and fundamentally it is. However, there is no doubt that considerable confusion has arisen from Korschelt and Heider's statement in this regard. Many invariably take it that, according to these authors, the insect abdomen is typically composed of ten somites and no more. Others may understand that the telson mentioned is formed of the eleventh and twelfth somites fused. As one can see from the work of the investigators themselves, they agree in giving eleven as the typical number of abdominal somites in the germ-bands of the insects upon which they worked.

One of the difficulties in arriving at any conclusion from the foregoing is that so few investigators have traced structures from embryonic through larval to adult stages, and this same difficulty confronts us when we review the work done on the genital appendages.

A marked deviation from the primitive condition is found in the lack, apparent, at least, of appendages on the adult abdominal somites. If one looks at the germ-band of an insect, however, one can see, soon after the appearance of the appendages of the head and thorax, anlages of a pair of appendages for each somite of the abdomen also. These rudiments are lateral, sac-like swellings, usually pointing backward, and generally considered as serially homologous with the thoracic legs, as also with the appendages of the head.

The first account of embryonic limb rudiments on the first abdominal somite of Gryllotalpa, was written by Rathke in 1844, and, later, on all the abdominal somites, by many others. As we mean by primitive, in insects, that which shows their close relationship to, and probable descent from, a myriapod-like form consisting of several, successive, similar somites, each having a pair of appendages, we are interested to look in the adult for traces of the embryonic condition described above.

4. GENITALIA.—There is, at the caudal end of the abdomen of every insect, a group of appendages having to do, more or less directly, with the function of reproduction. Three pairs of these appendages taken together are called, in a general way, by German authors, "Geschlechtsanhänge"; by English and American ones, "genital appendages," "genitalia," or "gonapophyses," the latter, a term introduced by Huxley in connection with the Crustacea, and used by many others to indicate part or all of these structures, in one or both sexes. They have also been given, individually, names differing from one another in, and characteristic of, each order, so that in some cases only a systematist of the group concerned could follow a description using them. These three pairs of appendages have been attributed to the three somites cephalad of the terminal or anal somite, which, as explained in the foregoing, is considered the eleventh by some and the tenth by others.

It would seem natural to homologize these appendages with the anlages of legs found respectively on the same somites of the embryonic germ-band, but there are at least two opposed views on this question. Lacaze-Duthiers, who published papers on the subject in 1849–52, did not so consider them, but regarded them as modified ventral sclerites of their respective urites, the latter being the name by which this author, followed in this respect by Berlese and others, called the abdominal somites.

Haase, much later, also stated that the gonapophyses were not true appendages, but, to translate, "integumental structures of a somewhat higher order than styles," meaning those styles which are inserted at the bases of the legs, in the coxæ of some Myriapods and Thysanura. Grassi in 1889 held a similar view. According to Wheeler, all these investigators based their conclusions solely upon comparative anatomical data. The following investigators, however, have regarded these appendages, genitalia or gonapophyses, as homologous with the true, so-called "ambulatory," "segmental," or "pedal" extremities, although they have differed a good deal in the details of their explanations: Weismann in 1866; Kræpelin in 1872; Kowalevsky in 1873; Dewitz in 1875; Huxley in 1877; Cholodkovsky in 1891; and Wheeler in 1893.

Korschelt and Heider state their point of view as follows: "We are here led to ask to what extent the external genital appendages, the so-called gonapophyses, are to be traced back to limb rudiments. The researches of Kræpelin and Dewitz have revealed that the ovipositors of the Hymenoptera and the Locustidæ, and the corresponding genital appendages of the male in these forms, are derived from the imaginal discs of the eighth and ninth abdominal somites, which, when they first appear in the larva, closely resemble the imaginal discs of the larva of Corethra, which yield the thoracic limbs." (p. 371.) Bütschli and others have therefore attempted to refer the gonapophyses of these forms to true, abdominal limb-rudiments. "In support of this assumption, we might point out," continue Korschelt and Heider, "that these imaginal discs develop from the abdominal rudiments present in the embryo." "It should, however, be mentioned," they assert, "that Haase, following Uljanin, has recently opposed this view, although, as it appears to us, with insufficient reason, maintaining that the gonapophyses should be regarded merely as secondarily acquired, external appendages."

Heymons is one of the strongest opponents of a homology between the genital appendages and the anlages of the segmental ambulatory ones of the embryo and the appendages of an ancestral form. He states in a résumé published in 1899 that after embryological investigations on a great number of species of Locustidæ, Gryllidæ, and Hemiptera, he has come to the conclusion that it is a fundamental principle, in the study of insect embryology, that there is present no genetic relationship between the embryonal anlages of the ambulatory appendages and the gonapophyses.

The entirely different results obtained by Wheeler, from his embryological work on Xiphidium, Heymons attributes to the fact of an unusually early origin of the genitalia in Xiphidium and other Locustidæ, even as early as the embryonal period before the atrophy of the anlages of the segmental appendages. Also, in addition to this fact, Heymons lays emphasis upon the very small size of the sternites in Locustidæ, which would very easily lead one to confuse the embryonic limb-rudiments and the developing genitalia or gonapophyses; while in other forms, he states, the sternites are much larger. In fact, Heymons asserts, from his investigations on *Lepisma saccharina* and certain Hemiptera, that the sexual appendages do not originate even in the same parts of the sternites where the above-mentioned anlages of segmental appendages are found. It seems unbelievable that an investigator who has had as much experience as Wheeler in the examination of insect embryos should have made the mistake attributed to him by Heymons.

The anlages of segmental appendages on the middle and cephalic, as well as on the caudal somites, degenerate during the embryonic stages, and some authors, Goosens and Knatz, for example, have thought that, for this reason, the prolegs of caterpillars first develop during larval life. To quote again from Korschelt and Heider: "We should here have to suppose, as Graber also has pointed out, an embryonic rudiment remaining for a considerable time in a dormant condition. On the whole, the embryonal data seem to support the view of Balfour which Cholodkovsky adopted, and to which Graber was inclined, that the abdominal appendages of the Lepidoptera and Hymenoptera are to be regarded as true limbs. We have already had several examples, in the Crustacea, of the disappearance and redevelopment of a limb out of a rudiment which has meanwhile been latent (Mandibular palp of the Decapod larva, Korschelt and Heider, Vol. II, p. 312; maxillipedes of the Stomatopoda, Vol. II, p. 300.) A similar example is afforded among the insects by the thoracic limbs of many Hymenoptera," and most Diptera for that matter. "These appear as rudiments in the embryo, disappear later, and reappear in the imago."

In the above-mentioned résumé of 1899 Heymons takes up, point by point, Verhœff's work on Coleoptera and Hemiptera, as well as his papers on Tracheates and Myriapods in general, all published between 1892 and 1898. From the results of his review of these investigations Heymons concludes that there is little support for Verhœff's opinions. The latter include the homology of the styles which are attached to the coxæ of the mesothoracic and metathoracic legs of Machilis, as well as to certain abdominal somites of other Thysanura. According to Heymons, Verhœff compares the style-bearing sclerites, which he considers laterad of, and fused with, the true abdominal sternites, with flattened out coxæ, and that rightly, according to Heymons; but, going further caudad, Verhœff also homologizes the median genital appendages with the distal segments of the legs, and the lateral gonapophyses with the coxæ of these legs, therefore regarding the origin of two pairs of genitalia from one pair of ambulatory appendages belonging to one somite, instead of from two pairs belonging to two successive somites, or, to put it from Heymon's point of view, from at least four isolated evaginations having no connection with the anlages of the segmental appendages found in the embryo.

One objection which may be made to Heymons's theory, on general morphological grounds, is found in certain of his conclusions which he himself states as follows: "Heymons zufolge, sind die Geschlechtsanhänge männlicher und weiblicher Insekten nur als Hypodermisfortsätze zu betrachten," and "Die Geschlechtsanhänge sind, nach der Ansicht von Haase, Peytoreau, Heymons, u. a. erst innerhalb der Klasse der Insekten erworben." With but few exceptions we find that, in tracing the morphological history of almost any organ's we may mention, more or less important and well developed in a group of animals, they have not recently "sprung into being" as it were. Nature is not in the habit, to put it differently, and perhaps in a trite, old-fashioned manner, of building structures out of "etwas Neues." A glance at the history of almost any vertebrate structure will reveal an example of this fundamental principle.

Wheeler realized the necessity of tracing organs not only in the embryonic stages, but also on through later ones. In his paper on Xiphidium he says that the embryonic history of the gonapophyses could be "continuously traced," since there is no flexure of the abdomen in that embryo as exists in so many other forms to obscure the ventral view of the somites. After the time of hatching, Wheeler calls attention to the fact that Dewitz, in 1875, traced the development of the ovipositor in another locustid, *Locusta viridissima*, so that we now have the complete history of that organ, or set of organs. Wheeler concluded that part of his account as follows: "While there can be no doubt about the appendages of the eighth and ninth segments which go to form the two outer sheaths of the ovipositor or sting, the development of the innermost blades is by no means so satisfactory. But whether this pair is only a portion of the ninth pair of appendages as most authors claim, or represents the tenth pair as I maintain, the main question at issue is in no wise affected; for it still remains true that the ovipositor consists of two or three pairs of modified ambulatory limbs." In the male Xiphidium embryo, it is claimed by Wheeler that the pair of appendages on the ninth somite persists, to form the definitive styli, those of the eighth and tenth somites disappearing very early. To quote again, "The continuity of the styli"—meaning here male genitalia—"with the embryonic appendages was quite as satisfactorily observed as the continuity of the ovipositor blades." He also says of the investigations of others, "Cholodkovsky has made an exactly similar observation on Blatta." The styli, therefore, in the male "are the homologues of the second pair of gonapophyses" in the female. "Haase must, therefore, have gone astray in seeking to homologize the styli" in the male, "with the styloid processes or 'Griffel'" above-mentioned in this paper as those styles attached to the coxæ of certain of the abdominal somites of some Thysanura, "for the styli," concludes Wheeler on the male Xiphidium, "are modified ambulatory appendages."

5. CERCI.—One more pair of appendages, namely, the cerci, should properly be included under the term genitalia, making the total number four pairs. The cerci, often tactile in function when present, are frequently described as attached to the terminal or anal somite. That different investigators have not meant the same thing, morphologically, by cerci, is undoubtedly true. Some regard them, not as appendages, but as prolongations of pleurites, *i. e.*, of epimerites and episternites. Berlese explains this point of view, which he apparently takes. He says that there may be cerci on the tenth somite, as also on the ninth, the presence of the one generally excluding that of the other,

although he would not lay this down as a fundamental principle. He gives Notonecta as an example of a case where he maintains that there is one pair of cerci on the eleventh somite, another pair on the ninth, and on somites cephalad of these he thinks there may be rudiments of others. His classification of cerci is as follows: the ones found on the eleventh somite, he calls acrocerci, or cerci; those on the tenth, mesocerci; and those on the ninth, procerci. The views of other authors are few in number, and have many points in common. Haase considers them as feeler-like appendages of the "Analstück"; Verhœff, true, segmental appendages of the tenth abdominal somite; Peytoureau, dorsal appendages of the tenth abdominal somite which may be compared, he thinks, with wings in their method of development.

Heymons and Wheeler in Orthoptera, and Heymons in regard to Dermaptera, Ephemerida, Odonata, and Thysanura agree that cerci are true appendages of the eleventh abdominal somite.

All of the foregoing opinions except Heymons's may be grouped together in that all their authors agree that the cerci are appendages, of one kind or another, belonging to the terminal abdominal somite. Heymons always regards the terminal anal somite as the telson, or twelfth abdominal somite, so would regard the cerci as appendages of the eleventh, or pre-anal somite. Verhœff lays great stress on the fact that the cerci must be segmented to be true cerci, comparing their segmentation with that of the thoracic legs. Haase and Heymons maintain that there is no relationship between the segments of these two structures as such, but rather a far-reaching, "weitgehende," according to Heymons—parallel between the cerci and the antennæ, not only in their present form, but in their ontogeny. It is certainly true that the cerci, generally speaking, bear a superficial resemblance to the antennæ, but they may also assume, physiologically, entirely different roles. Thus, for example, they may be purely sensory, but they may also be modified as accessory copulatory organs.

Cholodkovsky was the first, in 1891, to uphold the fact that the cerci were morphologically true pedal extremities, and it is the one place where Heymons can agree with him, as well as with Wheeler and others, that a pair of appendages which may properly be included under the genitalia has its origin in the anlages of the appendages of an embryonic somite. In fact, Heymons has called the cerci "modifizierte Extremitäten," and he states very emphatically that the cerci are homologues of the above-mentioned styles of some Thysanura, just as those styles themselves are descended from ancestral abdominal appendages.

6. ACKNOWLEDGMENTS.—It is with the foregoing points of theoretical importance in mind that the following investigation is presented. At this point it would seem fitting to state that the investigation was begun at the suggestion of Dr. Alex. D. MacGillivray, of the Department of Entomology, University of Illinois, and I wish to express my gratitude to him for that and for countless timely suggestions and criticisms. I am indebted to Professor S. A. Forbes for many courtesies and for the use of material from the Illinois State Laboratory of Natural History, and also to the staff of that institution. I also desire to thank Dr. Harris H. Wilder, of the Department of Zoology of Smith College, for many important suggestions and criticisms. Dr. H. S. Pratt, of the Department of Zoology of Haverford College, very kindly collected for me specimens of Mantis sp. from a colony introduced on nursery stock, near Haverford, and I would at this point express to him my thanks. For considerable mechanical help with the drawings and their arrangement in the plates, I am very grateful to Miss N. B. Lewis, of Smith College.

7. MATERIAL.—The records upon which we must rely in determining the origin of the genitalia are the anatomy of generalized adult forms, a comparison of these with more specialized species and earlier developmental stages. Therefore, this paper consists of a comparative study of the caudal segments and appendages of adults of the following species: *Lepisma saccharina* and *Machilis* sp. of the Thysanura; *Periplaneta orientalis*, *Melanoplus differentialis*, *Dissosteira carolina*, *Xiphidium ensiferum* and *Gryllus pennsylvanicus* of the Orthoptera; *Tibicen septemdecim*, *Notonecta undulata*, *Benacus griseus*, *Corixa* sp., *Anasa tristis* and *Euschistus variolarius* of the Hemiptera; *Corydalis cornuta* of the Neuroptera; *Panorpa lugubris* of the Mecoptera; *Nerophilus californicus* of the Trichoptera; *Harpalus caliginosus*, *Cybister fimbriolatus*, *Hydrophilus triangularis* and *Doryphora decemlineata* of the Coleoptera; *Hepialus humuli*, *Prionoxystus robiniæ*, *Agrotis ypsilon*, *Anosia plexippus* and *Phlegethontius sexta* of the Lepidoptera;

Tipula abdominalis, *Tabanus sulcifrons* and *Calliphora viridescens* of the Diptera; and of the Hymenoptera, *Dolerus unicolor* and *Vespa maculata*.

II. INVESTIGATION.

GENERAL PRINCIPLES.—Before taking up any anatomical description or comparison of the foregoing forms, a number of preliminary points should be mentioned.

The distal pair of appendages, as has before been noted, is the cerci, and in the majority of cases in adult insects where these are present they have so changed their position as to be dorso-lateral, or even quite dorsal. As many of the succeeding pairs of appendages as are present are, as a rule, still in a ventral position, and may project beyond the caudal end of the abdomen. Therefore, it will usually seem convenient to begin descriptions of the genitalia by describing the cerci first.

Of the two sexes the female is the more generalized. A good example of this point is seen in the female cockroach where all four pairs of genital appendages are present, almost in their primitive position so far as showing their points of attachment to their respective segments is concerned, and where the total number of segments found in adult insects is also present. The saw-fly is another striking example of the generalized female. These are both examples in primitive families of insects, but on the other hand, in certain specialized groups which do not sting, and which, laying their eggs merely on the flat surfaces of leaves or stems, lack ovipositors, the caudal end of the abdomen presents a most generalized condition, the appendages in such cases being, "specialized by reduction." The genital and anal openings in these insects may be easily seen in a caudal view, the former between the ninth and tenth sternites under the edge of the ninth, and the anus in its usual position between the distal tergite and its corresponding sternite. These openings and whatever rudimentary appendages there may be present are enclosed within a cavity formed by the invagination of the segments beyond and including the eighth. From this sac-like invagination, the appendages may be protruded. When ovipositors and stings are present in specialized forms, these too are often concealed, or at least partially so, in pocket-like cavities similar to the one described above, except that they are usually somewhat longer.

The genital opening of the male is connected with the tenth sternite more closely than with any other, as Berlese states. However, certainly in the adult insect, it is also situated at the distal end of an intromittent organ, which is, in many cases when entirely protruded, nearly as long as the abdomen, and thus the ejaculatory duct is also prolonged to an equally great length, therefore, bringing the external opening itself to a point without any relation to the abdominal sclerites.

Somewhat similar cases occur in such females as possess long ovipositors. However, the distal opening of the vagina itself is seldom situated far beyond the bases of the ovipositors. When the eggs leave this opening, they follow along well-marked grooves on the inner surfaces of the ovipositors into the ground, stem, or other object in which they are to be laid. This same mechanism may exist for the exit of poisonous fluids exuded at the bases of stings, or, as is often the case, through excurrent ducts leading from the glands to an external opening, or paired openings, also situated at the bases of the stings.

In those insects which have their caudal segments and genitalia retracted, the caudal end of the body has a smoothly rounded contour, or it may even be pointed. Excellent examples of such cases are seen in the Diptera and Hymenoptera. In these, one is unable to identify the sex from the genitalia unless they are extruded, but one must instead use other characteristics varying in the two sexes—those commonly called secondary sexual characters. Those abdomens which terminate with most of their distal segments and appendages in view, show projections of a tactile, clasping, or other function, and, although usually bilateral in arrangement, they are very irregular in appearance by contrast with those smooth forms described above. Here, of course, it is very often possible to tell the sex easily from the genitalia alone.

The anus is always surrounded by cuticular membrane divided into folds generally called anal lobes. It is often difficult to decide upon the number of the distal segment in adult insects because it cannot be differentiated from this membrane which may very well be made up, morphologically, of more than one segment.

In numbering the segments of this region it is not necessary to begin with the first abdominal one. The most caudal pair of abdominal spiracles typically occurs in the eighth abdominal segment of adult insects, but is sometimes concealed if the posterior segments are retracted; otherwise, it is in the seventh, and the arrangement in this particular is quite uniform throughout an order. As, for example, there are always eight pairs of abdominal spiracles in the Orthoptera but only seven pairs in the Lepidoptera, with the possible exception of Hepialus. The fact must not be lost sight of that in the larva of this form eight pairs of functional spiracles are present, and that these are rudimentary in the pupa. The caudal appendages of the abdomen, the genitalia, are designated in this paper by the Roman numerals I, II, III and IV, beginning with the cephalic pair. No attempt has been made to apply the names given by systematists to these parts.

With the foregoing general principles in mind, some account of the details of the work may now properly be considered.

METHOD OF PREPARATION.—The method of preparing insects for a study such as the following is very simple. They were softened by leaving the entire insect, the abdomen only, or merely the posterior end, whichever was desired, in a five per cent solution of caustic potash for periods varying from twelve to twenty-four or thirty-six hours, depending upon the hardness and freshness of the specimens used. If pinned specimens were used, they were first boiled in water for a short time. They were then washed in running water, and studied under a binocular dissecting microscope. A compound microscope was also used for studying mounted balsam preparations of the smaller parts.

DISCUSSION AND TABLES.—The arrangement of this section of the paper will be as follows: The Apterygota will be taken up first, and next the Pterygota, beginning in each case with the generalized forms. There are also included tables showing the sclerites and appendages present in the species studied. The presence of a sclerite or a pair of appendages is indicated in the tables by a plus sign, and their absence by a minus sign. When either is rudimentary, an asterisk is added to the plus sign. The abbreviations t and s stand for tergum and sternum respectively.

a. *Thysanura.*—It is obvious from the figures of both Lepisma and Machilis that the problem is complicated in the Thysanura rather than simplified, as would seem natural. It is here that Heymons makes his best point in regard to the homologies between styles and genitalia, but in these forms both styles and appendages are often attached to the same somites. A careful survey, however, of Figure 12 (Plate IV) of the more generalized female shows that the latter are important outgrowths, which so far as the adults are concerned, may far better be considered genitalia than styles. In the embryos figured by Heymons the buds, anlages of genitalia and styles, are so near together as to be easily confused and to give ground for the belief that they are one and the same thing, not separate from the very beginning. On the other hand, this separation shows very clearly in his figures, even in those of insects which have entirely degenerate styles; that is, none, in the adult. He, however, does not interpret his figures nor yet his material in that way. He considers that the appendages found in the adult are simply the final specialization of these same above-mentioned styles.

In the male and female Lepisma (Plate IV, Figs. 6, 7, 10, and 12), again it is evident that in the adult insect there are appendages corresponding to Appendage I as well as styles, on the same somite, and it seems unnecessary to correlate those appendages found on the terminal somite of Lepisma and Machilis with styles when they resemble so closely certain appendages, cerci or Appendage IV, of similar form in many groups where styles are not present. It should be said in this connection that the terminal median appendage present in the Lepisma and shown in the figures of that insect is the one which, including also the anal lobes, Heymons and Uzel homologize with the eleventh somite.

TABLE OF SCLERITES AND APPENDAGES.

	SOMITES					APPENDAGES			
Lepisma saccharina	7,	8,	9.	10.	11.	I,	II,	III,	IV.
Female	t+	t+	t+	t+	t+	+	+	+?	+
	s+	s+	s+	s+	s+				
Male	t+	t+	t+	t+	t+	+	+	+?	+
	s+	s+	s+	s+	s+				
Machilis sp.									
Female	t+	t+	t+	t+	t+	+	—	—	+
	s+	s+	s+	s+	s+				
Male	t+	t+	t+	t+	t+	+	+	+?	+
	s+	s+	s+	s+	s+				

b. Orthoptera.—In regard to the Orthoptera it may be said that they are of course here, as elsewhere in structure, a very generalized group. To begin with, the tables show the presence of eleven, or at least parts of ten, somites and all four pairs of appendages in all the forms studied. This is particularly remarkable in connection with Appendage II, the commonly called "mesal," or "median" pair of appendages, which are so many times entirely lacking in the female.

In no case is the latter pair so prominent in the above mentioned genera as in Mantis. However, in case of every modification of the genitalia, whether it be for the purpose of digging in the ground, as is true in the grasshopper and the cricket, or whether for holding the spermatophore, the habit of the female Xiphidium, it is possible easily, not only to work out and see plainly this appendage, Appendage II, but also to see that it follows immediately upon Appendage I in an extreme ventro-caudal position.

Table of Sclerites and Appendages.

	SOMITES					APPENDAGES			
Periplaneta orientalis	7,	8,	9,	10,	11	I,	II,	III,	IV.
Female	t+ s++	t+ s+	t+ s+	t+ s+	t+ s+	+	+	+	+
Male	t+ s+	t+ s+	t+ s+	t+ s+	t+ s+	+	+	+	+
Melanoplus differentialis									
Female	t+ s+	t+ s+	t+ s+	t+ s+	t+ s+	+	+	+	+
Male	t+ s+	t+ s+	t+ s+	t+ s+	t+ s+	+	+	+	+
Dissosteira carolina									
Female	t+ s+	t+ s+	t+ s+	t+ s+	t+ s+	+	+	+	+
Male	t+ s+	t+ s+	t+ s+	t+ s+	t+ s+	+	+	+	+
Xiphidium									
Female	t+ s+	t+ s+	t+ s+	t+ s+	t+ s+	+	+	+	+
Male	t+ s+	t+ s+	t+ s+	t+ s+	t+ s+	+	+	+	+
Gryllus									
Female	t+ s+	t+ s+	t+ s+	t+ s+	t+ s+	+	+	+	+
Male	t+ s+	t+ s+	t+ s+	t+ s+	t+ s+	+	+	+	+

c. *Hemiptera.*—In many species of this order we meet the problem presented by Berlese's theory of successive pairs of cerci, which he illustrated by many examples from the Hemiptera. At the posterior end of Benacus, Zaitha and other species of aquatic Hemiptera, in both the male and female there projects a pair of strap-like appendages, included by some authors among the genitalia. Upon a close examination they are found to be outgrowths of the eighth tergites, and the corresponding pair of spiracles is situated at their bases. From these spiracles two parallel rows of closely set setæ extend to the distal ends of these projecting tergites. Various observers have believed them to be organs used in connection with the respiration of these aquatic species. The seventh tergite of Benacus presents a similar modification, and it contains the seventh pair of spiracles, but it is much broader and shorter. The seventh and eighth tergites of Notonecta and the eighth tergite of Corixa are apparently lengthened in like manner, and, according to some investigators, have also a like function. *Euschistus variolarius* and *Anasa tristis*, among the land forms, show similar projections from the tergites of this region, but lack the arrangements of setæ which have to do with the respiration of the aquatic species. However, in neither case are these parts separated from the sclerite proper, as is always true of the cerci, whether or not they show segmentation. In this connection, it may be noted that these prolongations in the Hemiptera, called by Berlese the cerci, are never segmented. The Hemiptera form a generalized order of insects, yet they are among the most specialized of those having an incomplete metamorphosis.

There are, therefore, few appendages present in certain of the more highly developed species, as is evident from the following table, and they are also specialized by modification in the form of complicated mechanisims. Examples of the latter are seen in the males of both Euschistus and Anasa.

TABLE OF SCLERITES AND APPENDAGES.

	SOMITES					APPENDAGES			
Tibicen septemdecim	7,	8,	9,	10,	11	I,	II,	III.	IV.
Female	t+	t+	t+	t+		+	+	+	+
	s+	s+	s+	s+					
Male	t+	t+	t+	t+		+	+	+	+
Notonecta undulata									
Female	t+	t+	t+	t+	t—	+	+	+	—
	s+	s+	s+	s+	s—				
Male	t+	t+	t+	t+	t—	+	+	+	—
	s+	s+	s+	s+	t—				
Benacus griseus									
Female	t+	t+	t+	t+	t—	+	—	+	—
	s+	s+	s+	s+	t—				
Male	t+	t+	t+	t+	t—	+	+	+	—
	s+	s+	s+	s+	t—				
Corixa sp.									
Female	t+	t+	t+	t+	t—	+*	—	—	—
	s+	s+	s+	s+	s—				
Anasa tristis									
Female	t+	t+	t+	t+	t+	+*	+*	+*	—
	s+	s+	s+	s+	s+				
Male	t+	t+	t+	t+	t—	+	+	+	-
	s+	s+	s+	s+	s—				
Euschistus variolarius									
Female	t+	t+	t+	t+	t—	+*	—	—	—
	s+	s+	s+	s+	s—				
Male	t+	t+	t+	t+	t—	+	+	+	
	s+	s+	s+	s+	s—				

d. Neuroptera.—Here again, among the first of those forms characterized by a complete metamorphosis, we find a more generalized condition than among the Hemiptera, which, although they have an incomplete metamorphosis, stand at the top of the group. Appendage II is lacking, but this is the above-mentioned "mesal" appendage more often absent than present.

To be sure, somite eleven is apparently entirely wanting, but without embryological evidence one has always a suspicion that parts of this segment may be present in the membrane of the anal lobes. Another point to be noted here, unlike any we found in the Orthoptera, is that the male appendages present almost as primitive a condition as do the female. In fact there is even less specialization in connection with function in the male than in the female.

TABLE OF SCLERITES AND APPENDAGES.

	SOMITES					APPENDAGES			
Corydalis cornuta	7,	8,	9,	10,	11	I,	II,	III,	IV.
Female	t+	t+	t+	t+	t—	+	—	+	+
	s+	s+	s+	s+	s—				
Male	t+	t+	t+	t+	t—	+	—	+	+
	s+	s+	s+	s+	s—				

e. Mecoptera.—*Panorpa lugubris*, the example chosen in this case, seems at first glance to be a most specialized insect, particularly so far as genitalia are concerned. This appearance is found to be, with very little and superficial examination, entirely misleading. The real situation at the posterior ends of both the male and female Panorpa is that of a generalized form. In the male there is a resemblance to the Lepidoptera in the claspers, which are not, however, the only appendages present as is usually the case in the larger group characterized by such organs.

TABLE OF SCLERITES AND APPENDAGES.

	SOMITES					APPENDAGES			
Panorpa lugubris	7,	8,	9,	10,	11	I,	II,	III,	IV.
Female	t+ s+	t+ s+	t+ s+	t+ s+	t+ s+	+	—	+	+
Male	t+ s+	t+ s+	t+ s+	t+ s+	t— s+	+	—	+	+

f. Trichoptera.—The male caddis fly is characterized by an apparent specialization, real indeed so far as function is concerned but not fundamentally affecting the relative arrangement of parts. The specialization is in connection with the prolongation merely of the ejaculatory duct, and is formed of Appendage II.

TABLE OF SCLERITES AND APPENDAGES.

	SOMITES					APPENDAGES			
Nerophilus californicus	7,	8,	9,	10,	11	I,	II,	III,	IV.
Female									
Male	t+ s+	t+ s+	t+ s+	t+ s+	t+* s+*	+	+	+	+

g. Coleoptera.—The Coleoptera have long presented a great problem to those investigators who wished to be able to make a classification of that group based on genitalia. So far as this paper is concerned they may still present almost unsurmountable difficulties. However, there is very little doubt that ten segments and even traces of eleven are present in the beetles, even if one must depend in large measure upon membrane only and asymmetrically placed sclerites. With relaxation by potash it is very evident that true somites eight, nine, and ten are present, the sutures between them showing plainly by means of evaginated folds or grooves. The eighth somite is always indicated plainly by the position of the eighth spiracle, no matter how much it is hidden from view at first glance. Appendages are in large measure lacking in the female and the appearance is that of extreme specialization by reduction. The male is modified especially in connection with the external opening of the ejaculatory duct, which is placed at some distance outside of the body-cavity, entirely out of relation to its respective somites 9 and 10.

Table of Sclerites and Appendages.

	SOMITES					APPENDAGES			
Harpalus caliginosus	7,	8,	9,	10,	11	I,	II,	III,	IV.
Female	t+ s+	t+ s+	t+ s+	t+ s+	t+ s+	+	—	—	—
Male	t+ s+	t+ s+	t+ s+	t+ s+	t— s—	—	+	+	—
Cybister fimbriolatus									
Female	t+ s+	t+ s+	t+ s+	t+ s+	t+ s+	+*	+	+	—
Male	t+ s+	t+ s+	t+ s+	t+ s+	t— s—	+	+	+	—
Hydrophilus triangularis									
Female	t+ s+	t+ s+	t+ s+	t+ s+	t— s—	+	+	+	—
Male	t+ s+	t+ s+	t+ s+	t+ s+	t— s—	+	+	+	—
Doryphora decemlineata									
Female	t+ s+	t+ s+	t+ s+	t+ s+	t— s—	+*	—	—	—
Male	t+ s+	t+ s+	t+ s+	t+ s—	t— s—	+*	+?	+	—

h. Lepidoptera.—The families of Lepidoptera present in the female, beginning with Hepialus, most extreme cases of specialization by reduction. The telescoping of segments is here carried to such a degree that we see for the first time the most terminal spiracle in the seventh somite instead of in the eighth, its usual position in a more typical form. It is interesting to note, in this connection, that this spiracle is present in the larva, rudimentary in the pupa, and lost in the adult, with the possible exception of Hepialus.

The somites retracted are very long in proportion to their width, and very slightly chitinized. Appendages in the female are largely lacking except perhaps for bud-like outgrowths from the somites at the positions occupied by appendages when present in other forms. The appearance of the female from the caudal point of view presents, particularly in Hepialus, because of this relation between somites and the origins of their respective pairs of genitalia, a most generalized condition. The use of the word generalized may be objected to in a case of such extreme specialization, but certainly the relation between somites and appendages is a primitive characteristic in itself, and one extremely prominent in this group.

TABLE OF SCLERITES AND APPENDAGES.

	SOMITES					APPENDAGES			
	7,	8,	9,	10,	11	I,	II,	III,	IV.
Hepialus humuli									
Female	t+ s+	t+ s+	t+ s+	t+ s+	t— s—	+*	—	—	—
Male	t+ s+	t+ s+	t+ s+	t+ s+	t— s—	+	—	—	—
Pryonoxystus robiniæ									
Female	t+ s+	t+ s+	t+ s+	t+ s+	t+ s+	—	—	—	—
Male	t+ s+	t+ s+	t+ s+	t+ s+	t+ s+	+	+	+	—
Agrotis ypsilon									
Female	t+ s+	t+ s+	t+ s+	t+ s+	t+ s+	—	—	—	—
Male	t+ s+	t+ s+	t+ s+	t+ s+	t— s—	+	+	+	—
Anosia plexippus									
Female	t+ s+	t+ s+	t+ s+	t+ s+	t— s—	—	—	—	—
Male	t+ s+	t+ s+	t+ s+	t+ s+	t— s—	+	+	+	—
Phlegethontius sexta									
Female	t+ s+	t+ s+	t+ s+	t+ s+	t+ s+	—	—	—	—
Male	t+ s+	t+ s+	t+ s+	t+ s+	t+ s+	+	+	+	—

i. Diptera.—The Diptera differ among themselves largely in presenting both very generalized and specialized conditions. The specialization, so far as appendages is concerned, is again one of reduction. The best illustration of generalization is seen in the female of *Tipula abdominalis* and specialization is evident in the tabanid. A caudal view (Plate XVI) illustrates extreme specialization by reduction with scarcely any appendages indicated except the cerci, Appendage IV. In this as well as in all cases of this type of specialization both the anal and the genital openings occupy their typical position. The male shows greater specialization both in Appendage IV and in the other appendages, especially in the one forming the case for the ejaculatory duct, Appendage II, but even here, comparatively speaking, specialization by modification and enlargement of parts is fairly slight.

TABLE OF SCLERITES AND APPENDAGES.

	SOMITES					APPENDAGES			
Tipula abdominalis	7,	8,	9.	10,	11	I,	II,	III.	IV.
Female	t+	t+	t+	t+	t—	+?	—	—	+
	s+	s+	s+	s+	s—				
Male	t+	t+	t+	t+	t—	+	+	+	+
	s+	s+	s+	s+	s—				
Tabanus sulcifrons									
Female	t+	t+	t+	t+	t—	—	—	—	—
	s+	s+	s+	s+	s—				
Male	t+	t+	t+	t+	t—	+	+	+	+
	s+	s+	s+	s+	s—				
Calliphora viridescens									
Female	t+	t+	t+	t+	t—	—	—	—	—
	s+	s+	s+	s+	s—				
Male	t+	t+	t+	t+	t—	+*	+	+	+
	s+	s+	s+	s+	s—				

j. Hymenoptera.—The connections of the 8th and 9th somites with their respective genitalia are very clearly seen, not only in the generalized saw-fly, Dolerus, but also in the specialized Vespa (Plate XVII). The genitalia, here having the form of saws and stings respectively, are in themselves very naturally greatly modified for their functions, but, except for their length and serrated edges, for example, there is very little about the posterior ends of the females of either of the above mentioned genera which indicates very great specialization. The one point which does strongly suggest such specialization is the complete retraction of parts in this region of the body so that without potash preparations one would see only a perfectly even contour in the caudal region of the abdomen.

The males of this order show numerous small modifications of all the genitalia, Appendages I, II, III, and IV respectively. These modifications are in the form of many irregular points, curved projections, finger-like evaginations, and other small structures hard to describe. The copulatory habits of these forms have been worked on so little that nothing can be said with regard to the meaning of all these structures. Their positions in relation to their respective segments are not difficult to make out, as is evident from the plates showing figures of these forms.

TABLE OF SCLERITES AND APPENDAGES.

	SOMITES					APPENDAGES			
[illegible]erus unicolor	7.	8.	9.	10.	11	I.	II.	III.	IV.
Female	t+ s+	t+ s+	t+ s+	t+ s+	t— s—	+	+	+	+
Male	t+ s+	t+ s+	t+ s+	t+ s+	t— s—	+	+	+	—
Vespa maculata									
Female	t+ s+	t+ s+	t+ s+	t+ s+	t— s—	+	+	+	—
Male	t+ s+	t+ s+	t+ s+	t+ s+	t— s+	+	+	+	—

III. SUMMARY.

Comparisons between certain of the somites of the different orders investigated, as well as between some of the appendages studied, may well be taken up as a summary of the above discussions and tables. The homology of the sclerites of the species studied, as well as that of the appendages, has been fully and clearly indicated in the labeling of the figures.

1. SOMITE EIGHT.—This somite, as has already been noted, contains, typically, the terminal pair of spiracles. Except in those species which have well-rounded contours, or are pointed, at the caudal end of the abdomen, this somite approaches very nearly the one figured in the so-called primitive type (Plate IV, Fig. 1). It is simple in outline; broad and blunt in shape; about one-third as long as wide; tapering only very slightly, if at all, and with a tergum and sternum almost equal in size, connected laterally by an appreciable conjunctiva; in the Thysanura, Orthoptera, Hemiptera, and in the generalized orders studied having a complete metamorphosis, such as the Neuroptera, Mecoptera, and Trichoptera. In the Coleoptera and Lepidoptera it is retracted; more or less membranous; long in proportion to its width; and, in the Lepidoptera, except for the possible case of Hepialus, it lacks its respective spiracle. It is also small in the higher families of the Diptera, but its extreme specialization occurs in the female Hymenoptera where the sternum consists of two small, sub-triangular sclerites to which is attached its respective pair of appendages, I, saws or sting as the case may be. (Plate XVII, Figs. 10 and 14).

2. SOMITE NINE.—This somite is more specialized than the eighth and markedly shorter in proportion to its width even in the Thysanura and Orthoptera. In these generalized orders of

insects, with incomplete metamorphosis, the ninth somite shows specialization in the sterum, which, early in its history in the female cockroach and grasshopper, is much smaller and far more variable in shape than the tergum. In the Hemiptera it is a larger, less modified somite, in the sternum as well as in the tergum, and this continues to be true in Corydalis and Panorpa, although it is longer in proportion to its width than before, this latter characteristic following out the' general shape of the scorpion fly. In the Coleoptera the entire somite consists of most irregularly shaped chitinous sclerites, and, in large proportion, of cuticular, non-chitinized membrane. Such sclerites may not be bilaterally placed with reference to the shape of the beetle, but in a direct ventral view only a part of the sternum will show, and that, irregular in shape, as in Hydrophilus (Plate XIII). In the Lepidoptera the ninth somite is often a homogeneous, membranous cylinder as in the females of Phlegethontius and Pryonoxyatus; or, as in the male of the same genus there may be a slender, curved sclerite bilaterally placed in a broad area of membrane; or, as is true of Hepialus the sclerites may be broad and short, more highly chitinized than the succeeding somites. In the Diptera it varies from the small, crescent-shaped sternum of the female *Tipula abdominalis*, to the broad, well-rounded tergum of the male in the same species.

Between these two extremes, one finds every irregularity, of size and shape, as is well illustrated by the long, sub-cylindrical somite of the male blow-fly and the irregularly chitinized, largely membranous sternum of the female of the tabanid. The corresponding sclerite in the male further accentuates the shape found in the female so that it is almost forked, the points projecting posteriorly and, in the female blow-fly we meet with an almost typical ninth sternum, its only variation being a somewhat curved caudal margin.

The ninth sternum is highly specialized in shape and arrangement in the Hymenoptera, after the same manner already commented upon in connection with the eighth, and it consists of two irregular sclerites again somewhat approaching a triangular shape. However, just as plainly marked as in the case of the eighth, is the primitive connection of this sternite with its respective pair of appendages: a most generalized point in a highly specialized group. It should also be noted that this generalized condition is almost as clearly seen in Vespa as in the saw-fly.

3. SOMITE TEN.—The typical form of this somite holds good, for the tergum in the male and female Lepisma, the sternum in these forms having as its main characteristic a deep indentation in the middle of the caudal margin. In the grasshoppers this tergum is narrow and only partly divided from the ninth by an incomplete suture, in both male and female, but the sternum is nearly typical. In the female cockroach it is so deeply indented in the middle of the caudal margin as to seem almost forked, and in the male this sclerite is very short with an entire, caudal margin, while the sternum is very small and retracted in both cases. In the male and female crickets the tergum is a sclerite nearly as long as broad, with a well-rounded caudal margin, but the sternum is smaller, much shorter than broad, and indented on the caudal margin, as is also the tergum of the female Xiphidium. The sternum again in this genus, as in all of the Orthoptera studied, shows specialization to a slight degree in its being retracted under the preceding sterna and terga with a consequent reduction in size. In the Hemiptera this small size of somite ten, with its accompanying retraction, is carried to a greater extent, and we have small sclerites, still chitinized, and, for all those studied, very well illustrated by the terminal tergum of Benacus which is typical of such sclerites, well developed, considering that they are retracted. The latter point is clear when such a tergum is compared with the tenth tergum or sternum of Euschistus. In all the Hemiptera studied there was quite perceptible chitinization of the cuticula forming the tenth somite, but this is lacking in the Neuroptera where membrane only is present. The somite in this case is not only short, but also small in circumference, entirely covered by other somites and appendages, and enclosing the anus without very well-marked sutures between the tergum and sternum. Such a description as this would answer for the tenth somite of almost any form taken through the remaining insect orders considered. Exceptions may be made in the case of Panorpa where the whole somite is long in proportion to its width, and firmly chitinized; in forms as reduced and retracted as Hepialus and Tabanus, where the length is very short in proportion to the width; in the female Pryonoxystus, where it is retracted and membranous, yet long and cylindrical.

4. SOMITE ELEVEN.—Somite eleven, as has been shown in the tables, occurs the most infrequently of any of the four caudal somites studied. It is the most characteristic of the Orthoptera of any order, although it also occurs in certain generalized families. When present it is posterior to the tenth, surrounds the anus, and is membranous except in such forms as the female grasshopper, where its tergum is highly chitinized, and clearly separated from the tenth tergum by a well-marked suture. Posterior to it in those cases, in the adult, lies the so-called twelfth somite of Heymons showing in both Dissosteira and Melanoplus (Plate VI, Figs. 9 and 10; 1, 10, 13, and 17, 12 very distinct in the female. This suture is not, however, present in certain nymphal stages, according to many investigators, even when it appears in the adult, and it would seem, therefore, to be a secondary modification. In other orders than the Orthoptera the eleventh somite is a short, homogeneous, membranous ring surrounding the anus, often distinguishable with difficulty from the anal lobes.

5. GENERAL STATEMENT.—Of the four somites considered above, it is evident that the ninth is the most specialized of all, both by reduction of parts, by modification of form, and by lack of chitinization—all three characteristics following upon retraction of the caudal end of the abdomen. Somite eight changes least from its form in the primitive type, and in the generalized Orthoptera, somites ten and eleven become the simplest in form, structure and substance, by specialization and reduction of parts.

6. APPENDAGE I.—This appendage occupies the most extreme ventro-caudal position, and shows its real connection with somite eight only in the saw-flies and wasps. This pair of appendages usually seems to be placed closely adjoining the ninth sternum, and is often referred to as the ventral pair of appendages. The ventral pair of ovipositors of the grasshopper (Plates V and VI) show this relative position, although the connection would appear at first glance to be with the eighth. This is also true in Appendage I in the female Lepisma. This appendage belongs to the eighth somite, but is often crowded out of its typical position by the shape, retraction, and function of the caudal somites. The Hymenoptera present another and one of the clearest cases of the relation between Appendage I

and somite eight, as has already been mentioned in another connection. This is well illustrated by the female saw-flies and Vespa (Plate XVII, Figs. 10 and 14) as well as by the generalized genus Lepisma in the male. The size of these appendages varies with their function. In the Orthoptera they attain a good size in all the forms studied, in both the male and the female, being more prominent in the latter. They are often apparently small tactile organs in the male when Appendages II and III are highly specialized, as in the case of Benacus, Euschistus and Anasa, Appendage I being even less conspicuous in the females of the two last mentioned genera, and somewhat smaller than in the male. In those groups having a complete metamorphosis it is either rudimentary, as in the female Hepialus; absent altogether as is most often the case in both the male and female of the Coleoptera and in female Lepidoptera other than Hepialus; or specialized as so-called claspers in most male Neuroptera, Mecoptera, Trichoptera, and Lepidoptera other than Hepialus. In the Diptera, it is rudimentary in the female Tabanus; of good size in both the male and female Tipula, and in the male Tabanus; and small in both sexes in Calliphora.

7. APPENDAGES II AND III.—These appendages are prominent in those females which have their genitalia specialized to dig holes in which to lay their eggs, to sting, or to perform some other accessory function. Examples of these are common among the Orthoptera and Hymenoptera (Plates V, VI, VII and XVII). Even here Appendage II, referred to above as the "mesal" appendage of certain authors, is small or rudimentary, and it is found to be more often absent altogether in the female than in the male. In the male these appendages are most specialized in connection with the intromittent organ, and Appendage II is more often present in the male than in the female. The best examples of this modification are seen in the Hemiptera and Coleoptera (Plates VIII, IX, X, XI and XII). Similar organs, much smaller in size, are also found in Corixa, Notonecta, Corydalis, Dolerus, and Vespa, made up, in all these cases of Appendage II, as well as III.

8. APPENDAGE IV.—Appendages included under this head are most often called the cerci. These are more dorsal in position than the others, and seem in many cases in adults, especially in the Orthoptera, to be as well attached to somite ten as

to eleven. (Plates V, VI and VII). Here we have the only instance of the association of one of the genitalia with terga rather than with sterna, so far as the sclerites are concerned, but the membrane forming the tenth and eleventh sterna is also in close contact with the base of this appendage. Wheeler, in his work on the embryo of Xiphidium, shows this appendage attached to the eleventh somite. It seems likely that variation in the form of these appendages accompanies a change in function. Evidence of this may be noted in the varied cerci of the Orthoptera, Neuroptera, Mecoptera, Trichoptera, and Diptera.

The main conclusion emphasized is the descent of the male and female genitalia from the anlages of abdominal, pedal extremities of a myriapod-like ancestor, as seen in the embryos of insects. The stylets upon which so much emphasis has been laid by investigators, mainly represented by Heymons, certainly have little place in the adult insect. That they are present in the Thysanura seems to have little weight after one has worked upon representatives not only of that order but of many other groups, because even where such stylets are present there are also present far more important structures, the above mentioned genitalia. Even in Heymons's figures it is clear that the two descended from entirely separate anlages, and the interpretation that the genitalia descended from the anlages of stylets seems entirely unnecessary, and in fact, in one case at least, entirely wrong.

That there are traces in the adult insect of ten, eleven, or possibly twelve somites, would seem but natural considering the probability of a far greater ancestral number, but only somites eight, nine, ten, and eleven bear a direct relation to the genitalia.

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V. EXPLANATION OF PLATES.

ABBREVIATIONS.

The following plates include figures of the posterior somites and appendages of the male and female forms of the insects studied. Other accessory points, such as external openings and their connections with their ducts, are shown wherever possible. Everything has been carefully and clearly labeled according to the following:

I	Appendage of Somite Eight.	Cop	Bursa Copulatrix.
II	Appendage of Somite Nine.	Cp	"Copulatory sacs."
III	Appendage of Somite Ten.	D	Ejaculatory Duct.
IV	Appendage of Somite Eleven.	G	Gland.
t1–t11	Terga One to Eleven.	Ov	Oviduct.
t12	Terga Twelve of Heymons.	R	Rectum.
s1–s11	Sterna One to Eleven.	Rp	Respiratoria.
A	Anus.	S	Spermatheca.
Ab	Anal Brush.	Sp	Spiracle.
Ap	Apodeme.	St	Stylet.
As	Appendages.	Tr	Tracheæ.
C	Cerci.	V	Vagina.
Con	Conjunctiva.	Vd	Vas deferens.

PLATE IV—PRIMITIVE TYPE AND THYSANURA.

Primitive type, Fig. 1, ventral view.

Machilis sp., 2, ♀, mesal view; 3, ♀, ventral view; 4, ♂, ventral view.

Lepisma saccharina, 5, ♀, dorsal view; 6, ♀, ventral view; 7, ♀, mesal view; 8, ♀, ventral view; 9, ♂, dorsal view; 10, ♂, ventral view; 11, ♂, mesal view; 12, 13, ♂, ventral views.

PLATE V—ORTHOPTERA.

Periplantea orientalis, 1, ♀, lateral view; 2, ♀, dorsal view; 3, 4, 5, 6, 11, ♀, caudal views; 8,♂, ental and mesal view; 9, ♀, ental view; 10, ♂, ventral view; 13, ♂, mesal view; 16, ♂, dorsal view.

Dissosteira carolina, 7, ♀, dorso-caudal view.

Mantis sp., 12, ♀, lateral view; 14, ♀, ventral view; 15, ♀, ental view.

Melanoplus differentialis, 17, ♂, dorso-caudal view.

PLATE VI—ORTHOPTERA.

Melanoplus differentialis, 1, ♀, lateral view; 2, ♀, mesal view; 4, ♀, mesal view; 5, ♀, lateral view; 6, ♂, lateral view; 7, ♀, ental view; 9, ♂, ventral view; 11, 12, ♂, mesal views; 13, ♂, dorsal view; 16, ♂, dorsal view; 17, ♀, dorsal view; 18, ♂, lateral view; 19, ♀, ventral view.

Dissosteira carolina, 3, ♂, ental view; 8, ♂, caudal view; 10, ♀, lateral view; 14, ♀, ental view; 15, ♀ lateral view; 20, ♀, mesal view.

PLATE VII—ORTHOPTERA.

Gryllus pennsylvanicus, 1, 5, 10, caudal views; 2, lateral view; 3, 6, ventral views; 7, ♀, dorsal view; 8, ♂, lateral and ental views; 9, ♂, ventro-caudal view; 10, ♂, caudal view; 11, ♂, ventral view; 12, ♂, dorsal view; 15, ♀, mesal view.

Dissosteira carolina, 4, ♂, caudal view.

Xiphidium ensiferum, 13, ♂, dorsal view; 14, 17, ♂, caudal view; 16, ♂, ventral view; 18, ♀, dorso-lateral view; 19, ♀, dorsal view.

PLATE VIII—HEMIPTERA.

Tibicen septemdecim, 1, 8, ♂, ventral views; 3, 12, ♀, lateral views; 9, ♂, dorsal view; 15, ♂, lateral view; 18, ♀, dorsal view.

Corixa sp., 2, ♀, ventral view; 19, ♀, dorsal view.

Benacus griseus, 4, 13, 14, ♀, lateral views; 7, ♀, ventral view; 6, ♀, dorsal view.

Notonecta undulata, 5, 22, ♂, lateral views; 10, 11, dorsal views; 16, 17, 21, ♂, ventral views; 20, ♀, ventral view.

PLATE IX—HEMIPTERA.

Anasa tristis, 1, 3, ♀, dorsal views; 2, 7, 8, ♀ ventral views; 5, ♀, dorsal and mesal views.

Corixa sp., 4, 6, 10, ♀, ventral views; 11, 14, ♀, dorsal views.

Notonecta undulata, 9, ♀, ventral view.

Benacus griseus, 12, 18, ♂, ventral views; 13, ♂, lateral view; 15, ♂, dorsal view; 16, ♂, mesal view; 17, ♂, lateral and ental view.

Notonecta, 19, ♀, ventral view.

PLATE X—HEMIPTERA.

Euschistus variolarius, 1, ♀, dorsal view; 2, 6, ♀, ventral view; 3, 8, ♂, dorsal views; 9, ♂, ventral view; 10, ♂, mesal view.

Anasa tristis, 4, 17, ♂, ventral views; 7. ♂, ental view; 14, ♂, caudal view; 15, ♂, lateral view; 18, ♂, dorsal view; 20, ♂, mesal view.

Notonecta undulata, 5, ♀, dorsal view.

Benacus griseus. 11, ♀, caudal view; 12, ♀, mesal view; 13, 16, ventral views; 19, ♂, ventral and ental view.

PLATE XI—NEUROPTERA, MECOPTERA, TRICHOPTERA.

Corydalis cornuta, 1, ♂, ventral view; 2, ♂, dorsal view; 4, ♂, ventral-caudal view; 5, ♀, dorsal view; 6, ♀, ventral view; 15, ♀, lateral view; 19, ♀, caudal view.

Panorpa lugubris, 3, 8, 21, ♂, lateral views; 9, ♂, mesal view; 11, ♀, ventral view; 12, 18, dorsal views; 14, ♀, ental and ventral views; 16, ♂, ventral view; 17, ♂, mesal and ventral views;.

Nerophilus californicus, 7, ♂, ventral view; 10, ♂, dorsal view; 13, ♂, caudal view.

PLATE XII—COLEOPTERA.

Harpalus caliginosus, 1 2, 7, ♀, dorsal views; 4, 5, 8, ♀, ventral views; 9, ♀, mesal view; 10, ♂, lateral view; 11, 13, ♂, dorsal views; 17, 23. ♂, ventral views.

Cybister fimbriolatus. 3, 18, ♂, ventral views; 12, ♂, mesal view; 14, 21, ♀, dorsal views; 15, ♀, lateral view; 19, ♂, dorsal view; 20, ♀, ventral view.

Doryphora decemlineata, 6, ♂, ventral view; 16, ♀, ventral view.

PLATE XIII—COLEOPTERA.

Hydrophilus triangularis, 1, 14, ♂, dorsal views; 6, 15, 16, ♂, ventral views; 7, ♀, ental view; 11, ♀, ventral view; 20, ♀, dorsal view.

Doryphora decemlineata, 2, 13, 18, ♂, ventral views; 4, 5, dorsal views; 10, 22, ♀, dorsal views; 17, ♀, ventral view; 24, ♀, ventral and ental views.

Cybister fimbriolatus, 3, ♀, ental view; 8, ♂, dorsal view; :, ♀. dorsal view; 12, 21, ♂, lateral views; 19, ♀, ventral view.

Harpalus caliginosus, 23, ♀, ental view; 25, ♀, lateral and ental view.

PLATE XIV—LEPIDOPTERA.

Prionoxystus robiniæ, 1, ♂, dorsal view; 2, 11, ♂, ventral views; 3, 9, ♂, lateral views; 4, ♂, mesal view; of genitalia; 5, ♀, dorsal view; 6, ♀, ental view of S. S; 8, 15, ♀, ventral view; 12, ♀, ventral view of 8th segment; 14, ♀, ental and lateral view; 17, ♀, lateral-ental view.

Hepialus humuli, 7, ♀, caudal view; 10, ♂, caudal view; 13, ♀, dorsal view; 16, ♀, ventral view; 19, ♂, lateral view; 22, ♀, lateral view.

Anosia plexippus, 18, ♀, lateral view.

Protoparce carolina, 20, ♂, lateral view.

Agrotis ypsilon, 21, ♀, lateral view.

PLATE XV—LEPIDOPTERA.

Agrotis ypsilon, 1, ♂, dorsal view; 6, ♀, dorsal view; 8, ♂, lateral view of genitalia; 11, ♂, ventral view.

Protoparce carolina, 2, ♀, dorsal view; 9, ♂, dorsal view; 12, ♂, ventral view; 14, ♂, lateral view; 15, ♀, ventral view; 16, ♀, lateral view.

Anosia plexippus, 3, ♀, dorsal view; 4, ♀, ventral view; 5, 10, ♂, ventral views; 7, ♂, dorsal view; 13, ♂, lateral view.

PLATE XVI—DIPTERA.

Calliphora viridescens, 1, ♂, dorsal view; 2, ♂, ventral view; 3, 7, ♂, lateral views; 4, ♀, dorsal view; 6, ♀, ventral view.

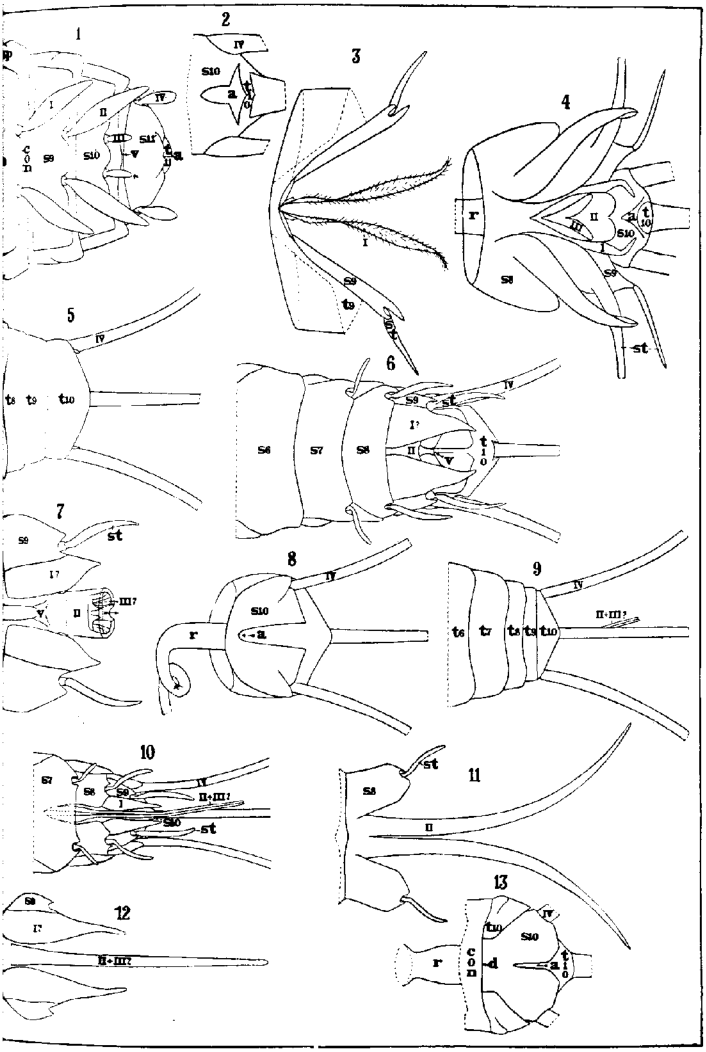
Tabanus sulcifrons, 5, 13, ♂, ventral views; 8, ♂, detail; 9, ♂, dorsal view; 10, ♀, caudal view; 11, 15, ♀, dorsal views; 12, 14, ♀, ventral views.

Tipula abdominalis, 16, ♀, ventral view; 17, ♀, dorsal view; 18, 22, ♂, ventral view; 19, ♀, caudal view; 20, 21, ♂, dorsal views.

PLATE XVII—HYMENOPTERA.

Dolerus unicolor, 1, ♀, dorsal view; 5, ♂, mesal view; 9, 19, ♂, dorsal views; 13, 15, ♂, ventral views; 14, 16, 20, ♀, ventral views.

Vespa maculata, 2, 11, ♀, lateral views; 3, 4, 8, 18, ♂, ventral views; 6, 17, ♀, dorsal views; 7, ♂, mesal view; 10, 21, ♀, ventral views; 12, 22, ♂, dorsal views.



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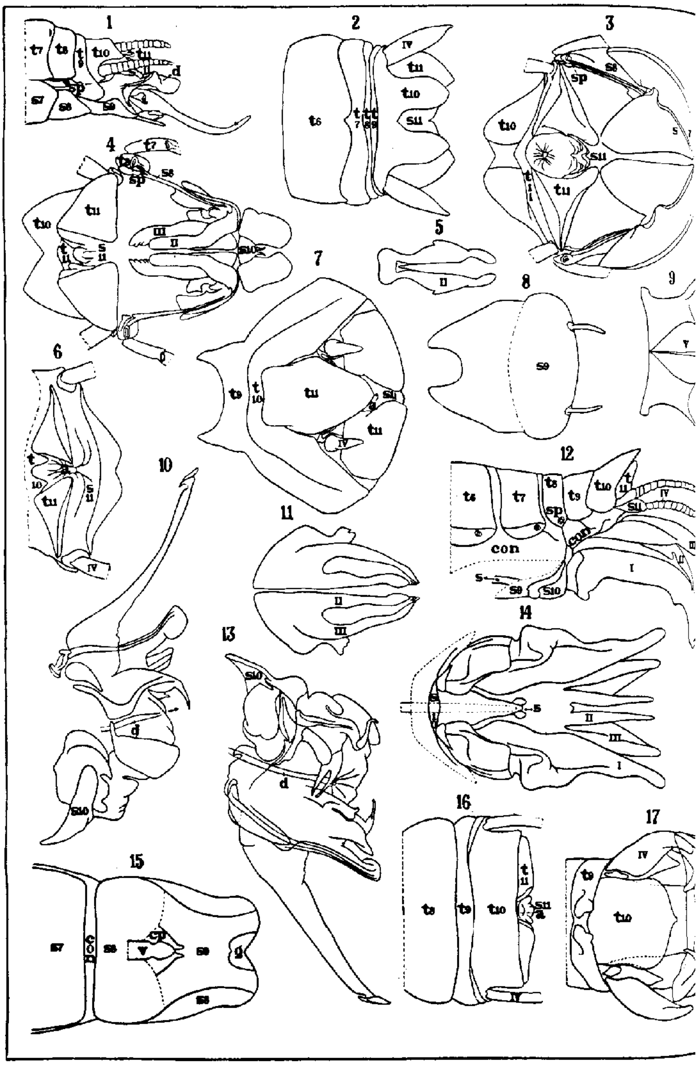

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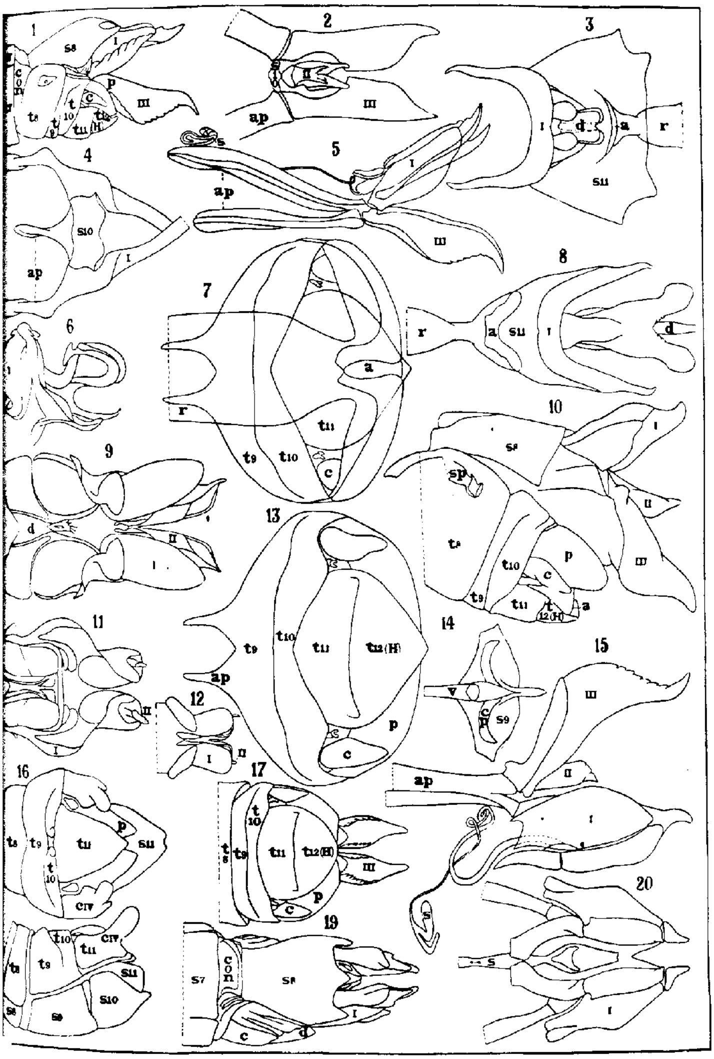

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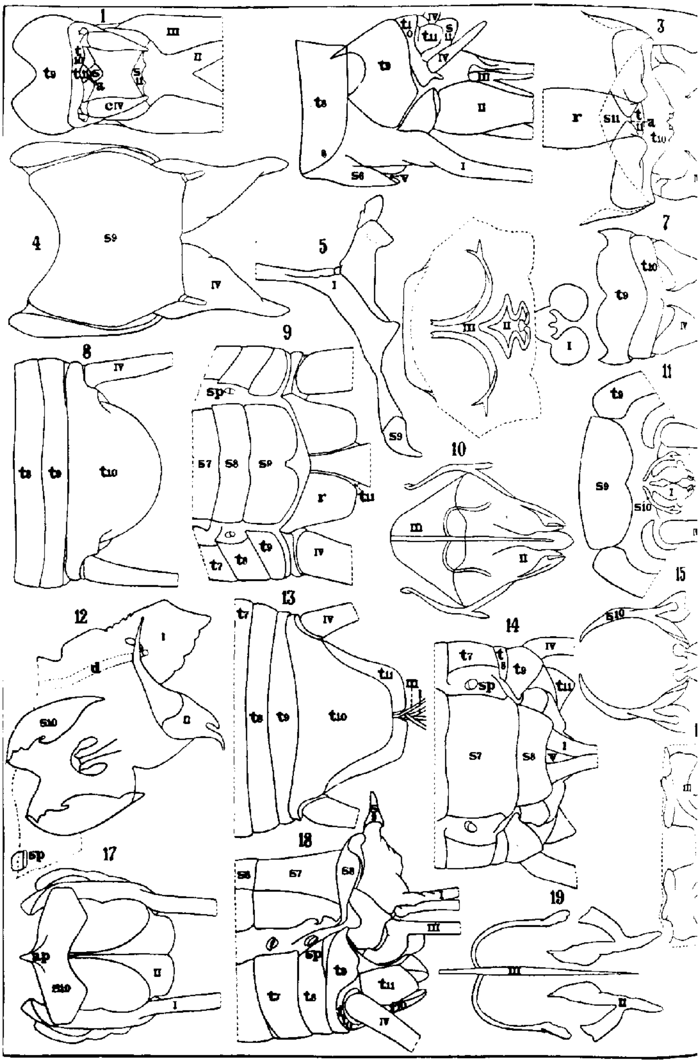

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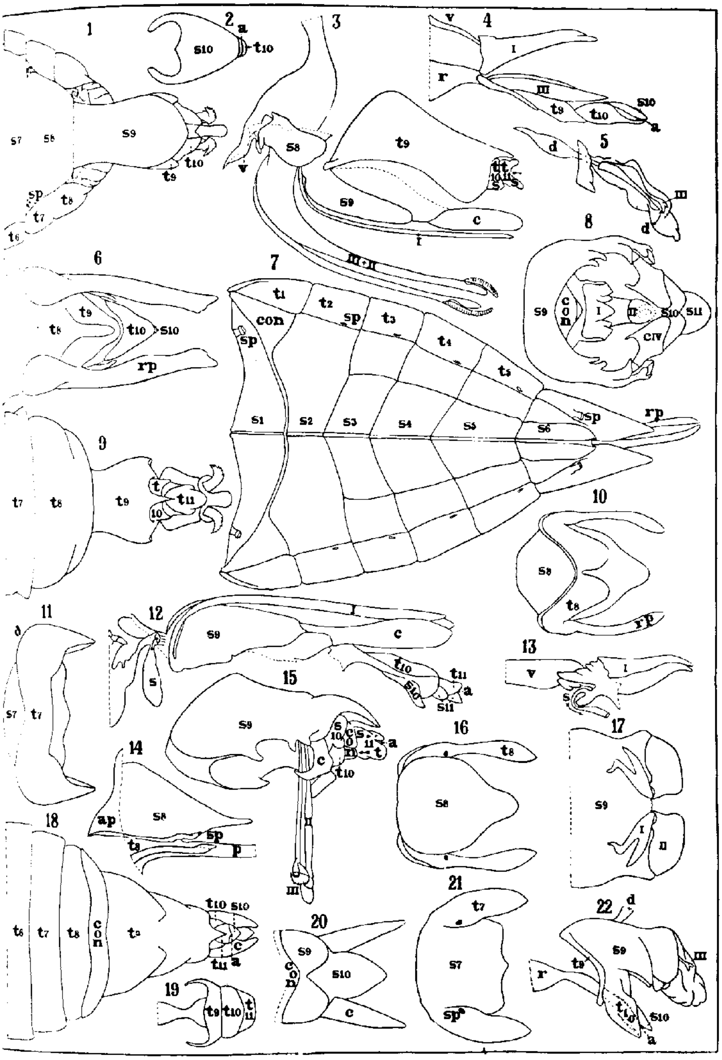

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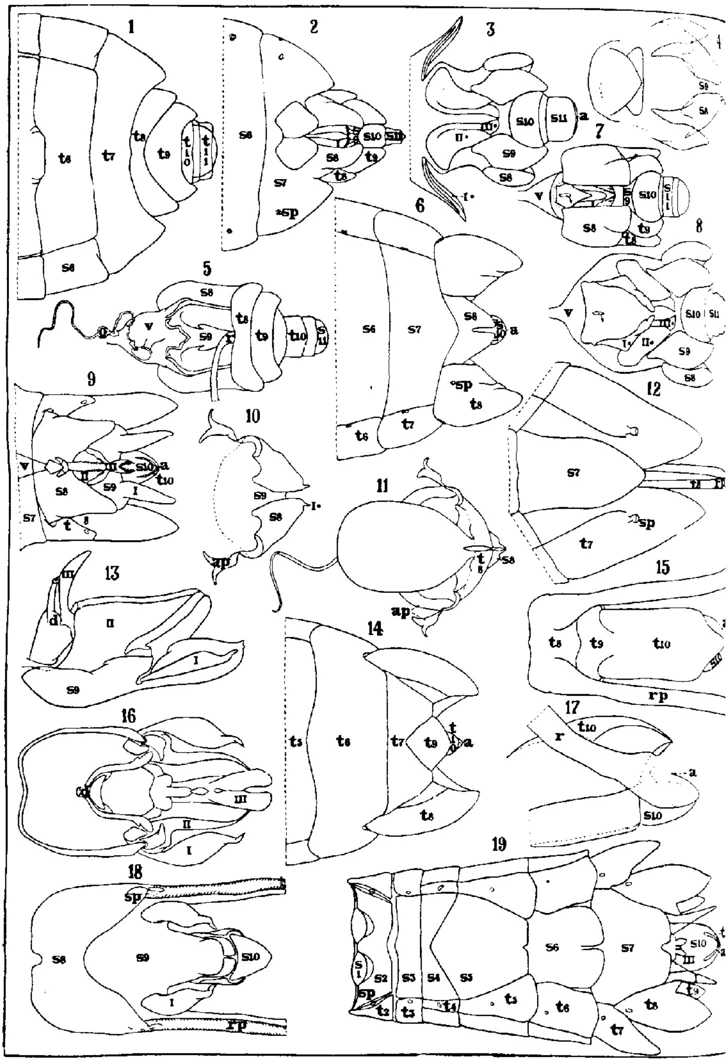

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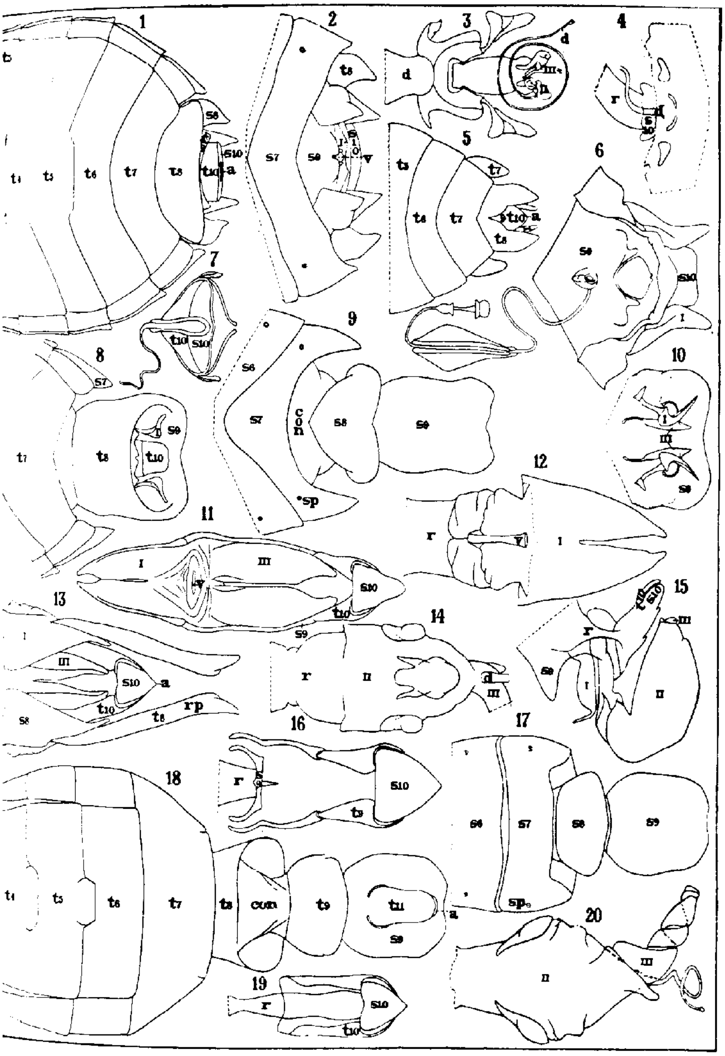
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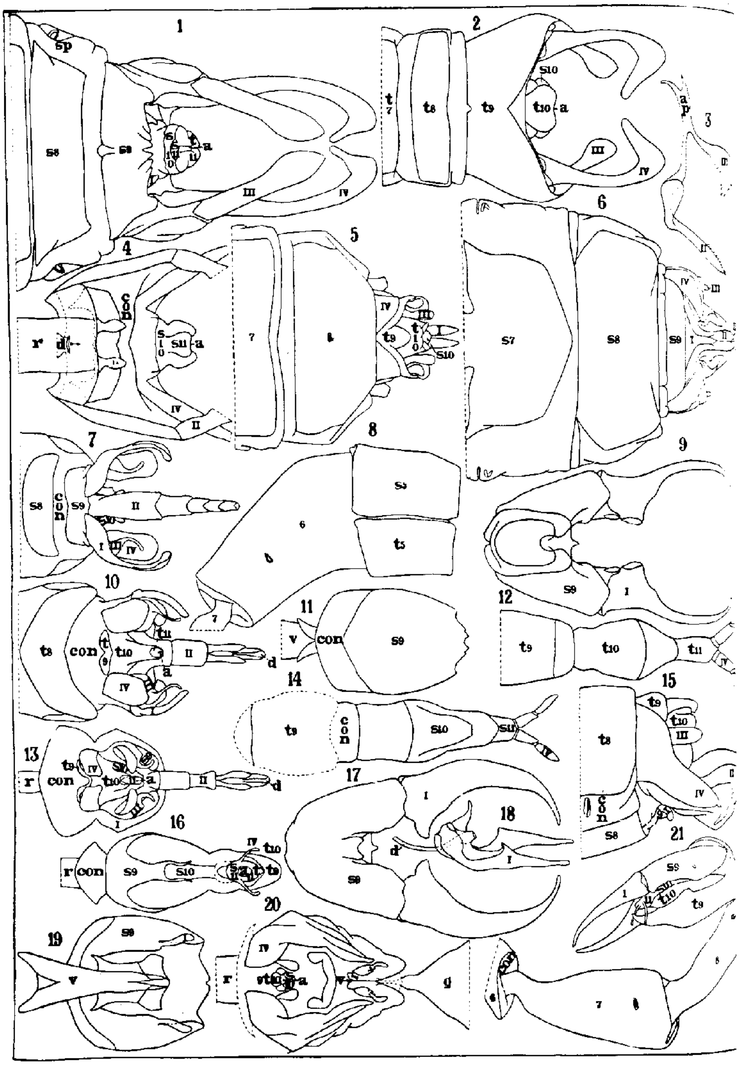

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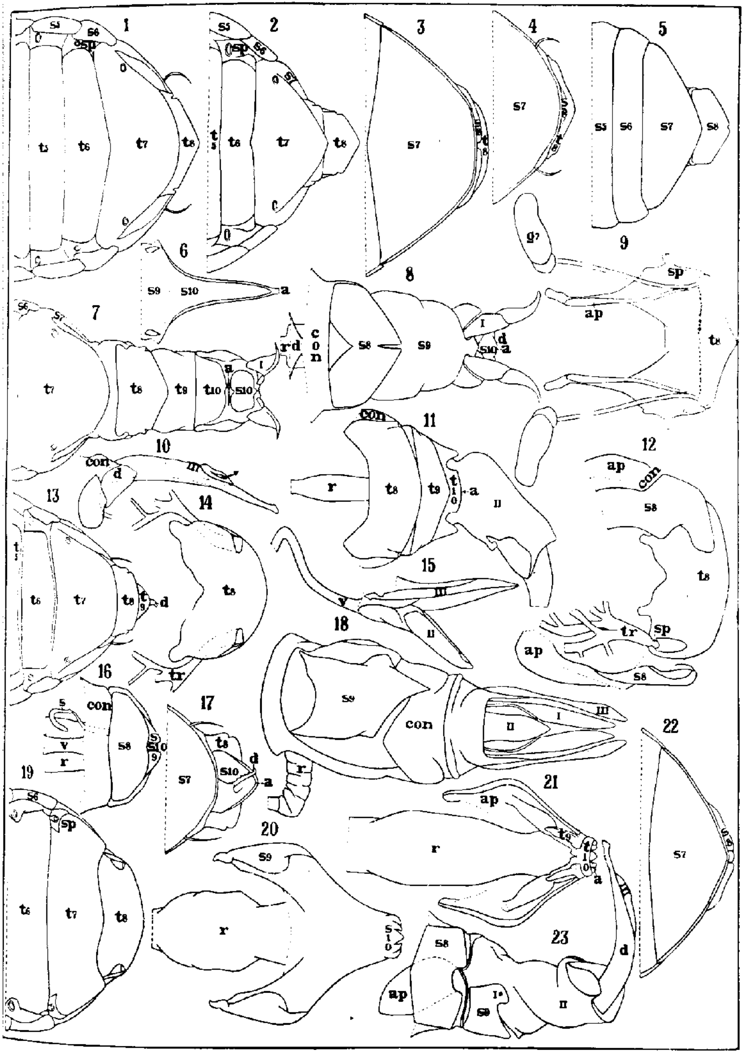

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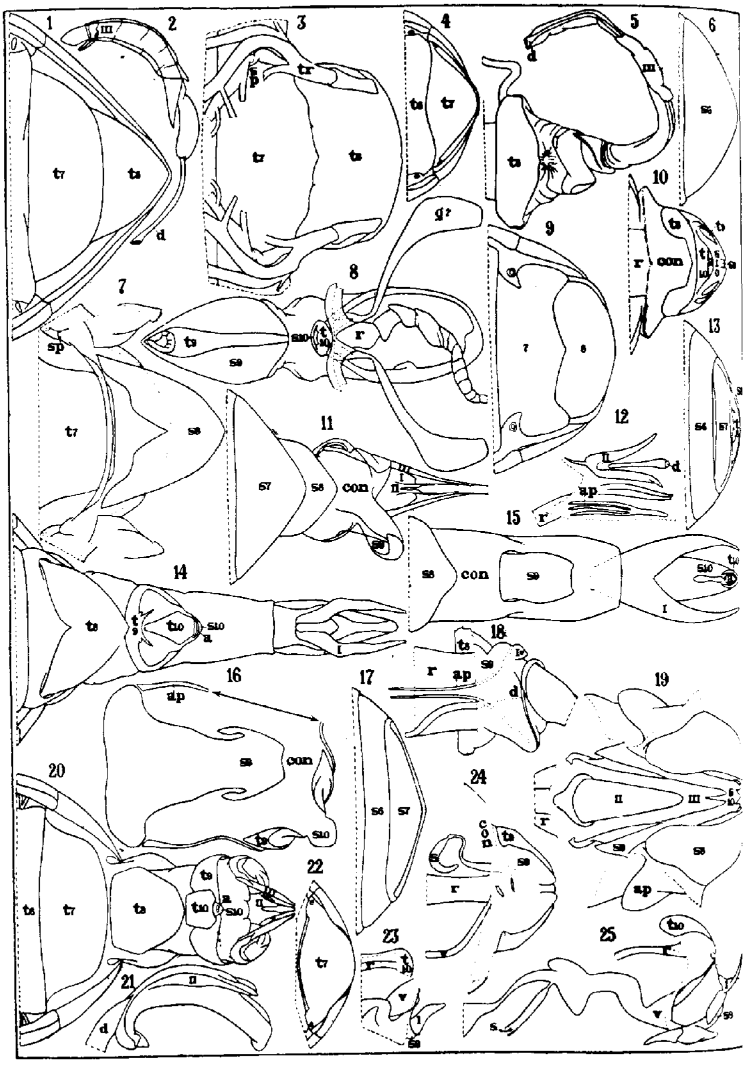

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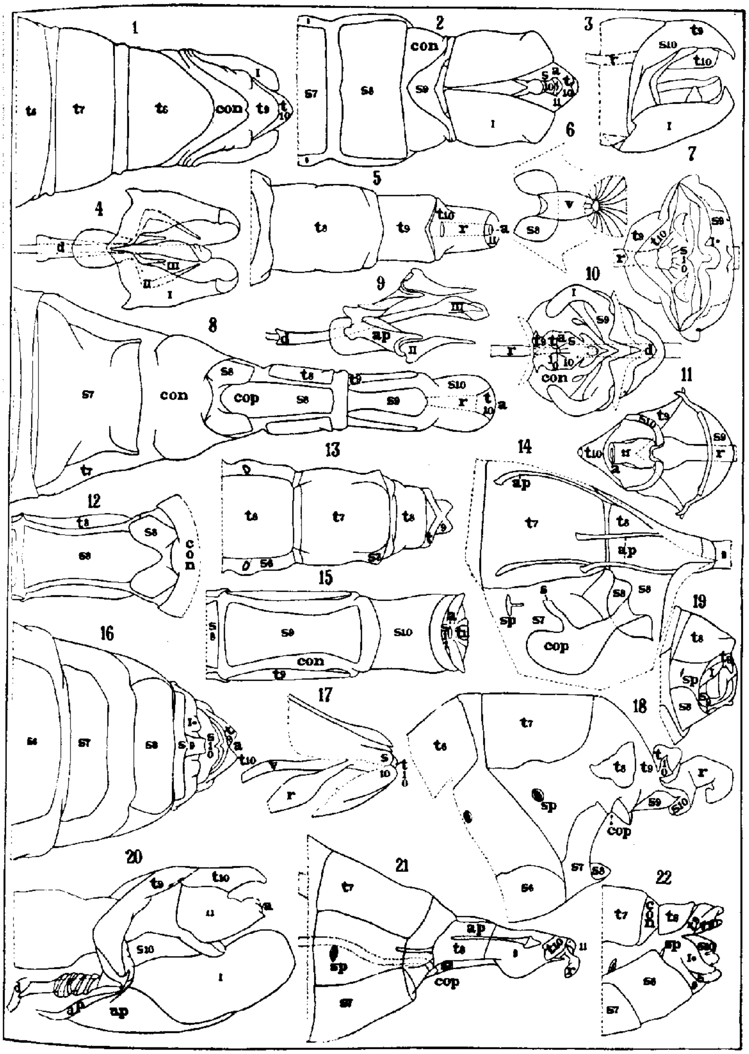

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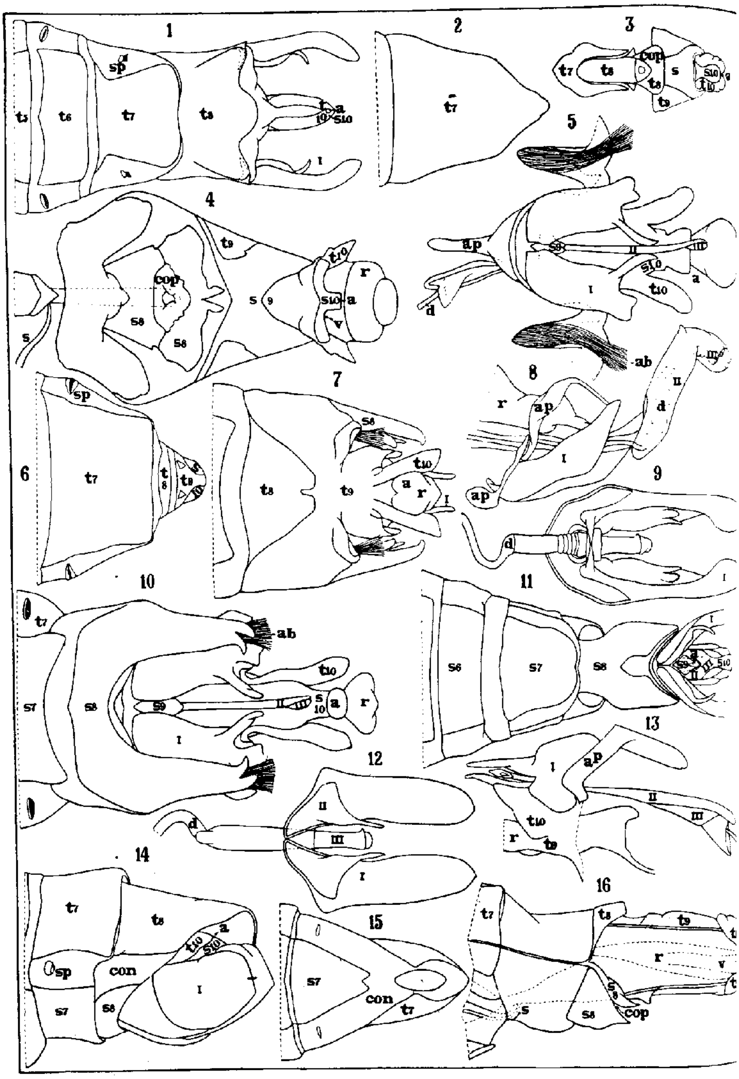

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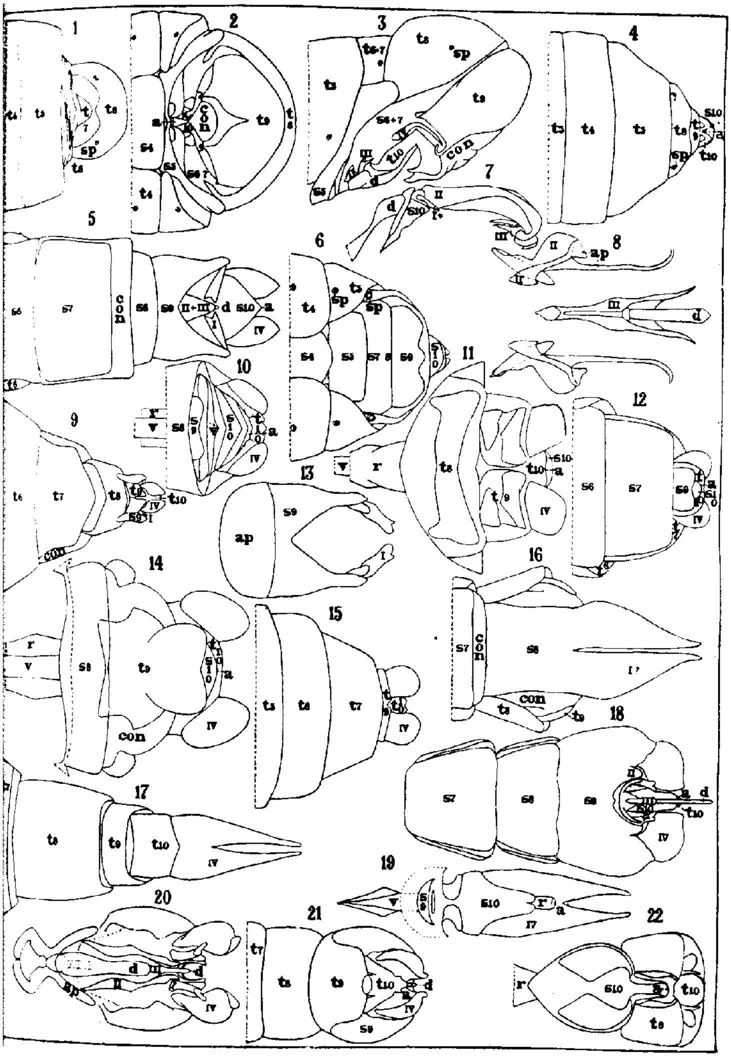

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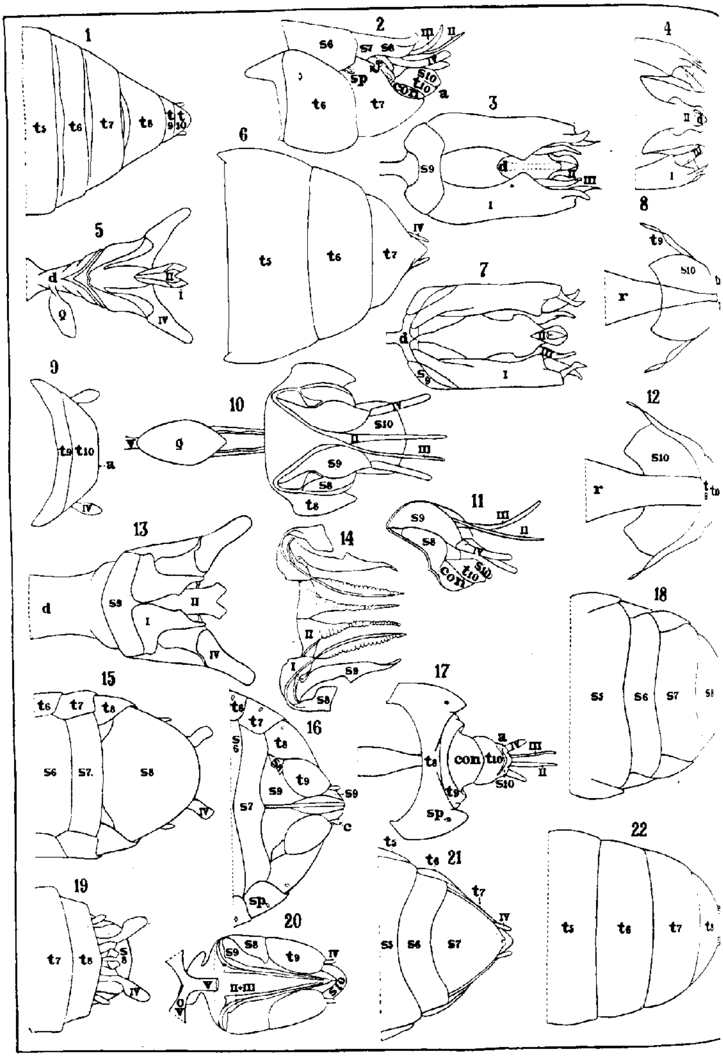

Anna Grace Newell

THE COCCIDÆ OF CUBA.*

J. S. Houser,
Ohio Agricultural Experiment Station.

The material upon which this paper is based was procured by the writer during the years 1908 and 1909, while in the employ of the Cuban government as assistant in the Department of Vegetable Pathology of the Central Agricultural Experiment Station. A portion of it consists of duplicates presented him from the collection of the department and the remainder was collected by him personally.

The department collection had been accumulated from specimens sent in for determination and from miscellaneous lots brought in at various times by members of the staff. No careful, systematic collecting had been attempted, except during the time which Mr. Wm. T. Horne, chief of the department, had spent investigating the troubles of Citrus fruits of the Island and during his work on the bud-rot of cocoanuts. Both of these studies extended over a wide range of territory and, as a sharp lookout was maintained constantly for scale insects, the Coccid fauna of the various Citrus plants and of the cocoanut must be fairly well represented in the collection.

The collecting by the writer was done mainly in the vicinity of Santiago de las Vegas and of Havana. The latter locality offered exceptional opportunities because of two botanical gardens which were placed at his disposal—La Jardin Botanica de la Universidad de Habana and La Jardin Botanica del Instituto de la Segunda Ensenada de Cuba. Not only was the work of collecting facilitated by finding in a relatively small area a large number of named host plants, but it seemed little had been done on the part of the gardeners by way of combating the Coccids and, as a result, the field was an unusually rich one.

Two ends were sought in the collecting: To secure as many species as possible and to enlarge the list of known Coccid host-plants. Immediately after it was collected, the material was dried in a slightly warmed oven and treated with flake naphthalene, the former to prevent development of molds and the latter to repel insects. Both operations are important in tropical and semi-tropical Coccid collecting, the former being particularly so if the season of collecting is wet. Moreover, material collected during the dry season of the year is of better quality than that collected during the rainy season, since in the first case the specimens are much less likely to be filled with entomogeneous fungi. For study, the Diaspine specimens were prepared by two methods. Where possible, at least one slide was prepared by the chloroform method in order to preserve and bring out the pygidial fringe and slow method caustic-potash slides were used in the study of the internal characters.

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* Contributions from the Department of Systematic Entomology, Cornell University, 1911.

ACKNOWLEDGMENTS.

This study was conducted under the tutelage of Dr. A. D. MacGillivray. To him the writer expresses his indebtedness. While residing in Cuba, several specimens were sent to Dr. C. L. Marlatt, for identification. These determinations have been of material assistance in checking the identification of others.

SCOPE OF THE WORK.

This paper deals mainly with the subfamilies Conchaspinæ and Diaspinæ, though a few species from other subfamilies are listed. Much material from the latter is on hand, still undetermined. Altogether, 368 lots of material were examined which yielded 36 species and 3 subspecies. One species and one subspecies are described as new to science. In working the material over, the writer felt some disappointment in the comparatively small number of species which it yielded. He expected at least as many as a collection of similar size from the Temperate Zone would contain. The explanation, however, lies in the fact that in our northern latitude, there is in reality both the Temperate and for the most part the Semi-tropical Zone to draw from; the latter because of the greenhouse and conservatory fauna, while in the South but one zone is available.

The arrangement of the species is in the order of their occurrence in Mrs. Fernald's "Catalogue of the Coccidæ of the World." On the final pages will be found tables for the differentiation of the species of *Conchaspis* and *Pseudischnaspis*.

ABBREVIATIONS.

In accrediting the collections the initials of the collector are used. Thus: W. T. H. = Wm. T. Horne, M. T. C. = Dr. Mel T. Cook, C. F. B. = C. F. Baker, W. A. P. = W. A. Page, J. W. S. = J. W. Stakley, S. P. S. = Sebastian Pla y Solarichs, E. W. H. = E. W. Halstead, J. S. H. = J. S. Houser.

Conchaspis angræci Ckll.

Host, Yucca gloriosa. *Locality,* Jardin Botanica del Instituto Segunda Ensenda de la Habana (Habana). *Date,* Feb. 2, 1909. *Collector,* J. S. H.

Asterolecanium bambusæ Bdv.

Host, Bambusa vulgaris. *Locality,* Rincon. *Date,* June 4, 1908. *Collector,* W. T. H.

Asterolecanium pustulans (Ckll).

Host, Fig. *Locality,* Santiago de las Vegas. *Dates,* May 18, 1905; July 22, 1908. *Collectors,* W. T. H., J. S. H.

Capulinia sallei Sign.

Host, unknown shrub. *Locality,* Lagoona Castellana, Santiago de las Vegas. *Date,* March 25, 1908. *Collector,* J. S. H. *Note.* The present is the third time this insect has been taken. The first record is that of Signoret, 1874, when the species was described. The type material was taken on "Capulino" in Mexico. The insect was rediscovered May 27, 1897, by C. H. T. Townsend, on "Escobillo" in woods Arroyo San Isidro (near Frontera) Tobasco, Mexico. The material of the present record was taken infesting both leaves and branches of an unknown hardwood shrub, growing near a lagoon situated in the midst of a cattle range of several hundred acres.

So unusual was the appearance of the insect that Prof. W. W. Froggatt, entomologist of Australia, who was with the writer at the time, was not even certain it was a Coccid. Later it was identified by Dr. Marlatt. The most striking characteristic of the insect is the long, white filaments which spring from the dorsum. In time these become wound and matted about the twigs and leaves, at first sight conveying the impression that a bird had been flying with a bit of cotton twine and the latter had become lodged and tangled on the twig.

Pulvinaria psidii Mask.

Host, Unknown wild plant. *Locality,* Calabazar. *Date,* May 3, 1908. *Collector,* W. T. H.

Ceroplastes cerripidiformis Comst.

Host, Wild shrub. *Locality,* Santiago de las Vegas. *Date,* May 18, 1905. *Collector,* W. T. H.

Coccus mangiferæ (Green).

Host, Mango. *Locality*, Santiago de las Vegas. *Date*, April 22, 1908. *Collector*, W. T. H.

Saissetia oleæ (Bern).

Host, Enterolobium cyclocarpum. *Locality*, Santiago de las Vegas. *Date*, December, 1906. *Collector*, W. T. H.

Chionaspis citri Comst.

Host, Citrus sp. Orange, French Lemon, Sweet Orange, Grape Fruit. *Localities*, Santiago de las Vegas, Buenaventina, Ciego d' Avila, Cristo, Ceballos, Herraduria, Bahia Honda, Camaguey. *Dates*, April 13, 1905. Aug. 31, 1906. Sept. 13, 1905. March 6, 1906. Dec. 25, 1907. Feb. 16, 1907. Dec. 11, 1907. *Collectors*, W. T. H., W. A. P., J. W. S. *Notes.*—A survey of all the material at hand shows that this species is variable, the principal differences being in the number and placing of the plates. In Comstock's description (p. 102, Cornell University Report, 1883), he says there is one plate near the penultinate segment (of abdomen). In these specimens there are two and three plates in this position. These specimens sometimes have two plates in one or several of the positions laterad of each lobe as against Comstock's one. In some of the specimens there are bifurcate instead of simple plates. All this material has two large marginal pores laterad of the fourth incision, disagreeing with Comstock's figure in which only one is shown.

Howardia biclavis Comst.

Hosts, Cestrum diurnum Lin., Leucæna glauca Benth., Hæmelia potens Jaco., Licuma nervosa A. C., Sapote, Magon, Cinnamonicum zeylanicum Breyn., Salix Bablionica L., Melicocca bijuga L., "Artea," Ficus carica L., Jatropha hastata., Meringa pterigosperma Gærtn., Egg plant, Tangarine, Canistel, Camito, Solanum cellicarpæfolium Kth., Leguminous liana Temerind 834, Malvaceous shrub, Ficus sp., Deheraimia cubensis Mez., Solanum verbasafolium L., Lantana sp., Maclura tinctoria Don., Sapindus saponaria L., Composite shrub, Carbonicella, "Diamela" Avocado, Malpighia punicifolia C., Mammea americana L., Jassamine, Calophyllum calaba Jacq., Ficus pertussa, "Anon," Guazuma tomentosa Sw., Athœa officinalis L., "Caymito" Fig., Eucalyptus, Psychatria. *Local-*

ities, Jardin Botanica del Instituto Segundo Ensenado de Cuba (Habana), Jardin Botanica de la Universidad de Habana (Habana), Santiago de las Vegas. *Dates*, Jan. 27, 1909; Feb. 2, 1909; Oct. 11, 1908; Oct. 21, 1908; Feb. 8, 1909; Feb. 16, 1909. *Collectors*, W. T. H., J. S. H., M. T. C. *Note.*—The so-called setæ of Comstock's description are dorsal wax pores.

Howardia biclavis detecta Mask.

Host, Spanish pear. *Locality*, Jardin Botanica de la Universidad de Habana, (Habana). *Date*, Jan. 27, 1909. *Collector*, J. S. H. *Note.*—Although the mounted insects resemble true *biclavis* Comst. in every respect, the specimens are placed under the variety *detecta* Mask. because the scale is not covered with bark. This according to Maskell differentiates the two. The bark of Spanish pear is very hard and smooth, so that it would seem almost impossible for a scale to mine beneath it; hence, it is the belief of the writer that the mining habit of *biclavis* Comst. is regulated by the food plant upon which it occurs and that the variety *detecta* Mask. is not valid. Further evidence on the point is brought out by an examination of a series of infested plants grading from those with soft and corky or flaky bark to those with a hard leathery sort. The insects are almost entirely hidden when they occur on the soft or flaky-barked sorts and that the quantity of covering gradually decreases as the opposite extreme is approached.

Diaspis boisduvalii Sign.

Host, Coconut. *Locality*, Baracoa. *Dates*, March 22, 1907; June 14, 1907. *Collector*, W .T. H. *Note.*—The writer is unable to place these specimens in any other species than *D. boisduvalii* Sign., though the insects at hand differ in several respects from it. The lateral margin of the median lobes is not attached to the body along its entire length, but the tip of the lobe is free. See Comstock (Report of Cornell University 1883, p. 87). In these specimens there is a distinct triangular projection between the median pair of lobes which is not figured by either Comstock or Newstead. The spines vary from Comstock's description; the second pair instead of being mesad of the plate between the first and second lobes is situated upon the median margin of the broad plate bearing the opening of the large dorsal wax pore between the first and second lobes. In his Monograph of the

British Coccids, (p. 154, Vol. I), Newstead states, "A long plate immediately follows the first three pairs of lobes." In my specimens there is a spine between the first and second lobes—not a plate.

Diaspis pentagona Targ.

Hosts, Peach, Ipomæa antillans. *Localities*, Tacajo, Calabazar. *Dates*, April 12, 1905; May 3, 1908. *Collectors*, M. T. C., W. T. H. *Note.*—This material does not agree perfectly with Newstead's figure, Monograph of the British Coccidæ, (Vol. I, p. 447). The mesal portion of the second pair of lobes is subequal in Newstead's figure while in these specimens it is much longer. These specimens usually have a trifurcate plate laterad of the second pair of lobes, where Newstead figures an ordinary plate; also these specimens have one to two pectinæ in the fourth position, while Newstead figures three.

Hemichionaspis aspidistræ Sign.

Hosts, Citrus trifoliata, Royal Palm, Wild legume. *Locality*, Santiago de las Vegas. *Collectors*, W. T. H., J. S. H. *Dates*, Nov. 16, 1908; Sept. 24, 1907.

Hemichionaspis minor (Mask).

Hosts, Lupiter, "Malba rosa," Melicocca bijuga L., Artea, Enterolobium cyclocarpum (Sw.) Gr., Wild trailing vine, Hibiscus sabodariffa, Sida carpinifolia, Tree cotton, Hennequin, Hibiscus, Citrus trifoliata, Plum, Bauhinia sp., Melina sp., Solanum verbasafolium L., Yucca gloriosa, Thumbergia grandiflora, "Sterculia," Mimosa asperata, Cajanus inducis Spr., Lonchocarpus latifolius, Althæa officinalis, Faberna, and Peach. *Localities*, Jardin Botanica del Instituto Segunda Ensenada de la Habana (Habana), Jardin Botanica de la Universidad de Habana (Habana), Habana, Santiago de las Vegas, Herraduria. *Dates*, Jan. 27, 1909; Dec., 1906; Dec. 17, 1907; Oct. 16, 1906; Feb. 16, 1907; March 15, 1908; Sept., 1906; Feb. 15, 1907; June 3, 1907; July 22, 1908; Oct. 11, 1908; Feb. 2, 1909; July 20, 1908; Feb. 16, 1909; Feb. 19, 1907. *Collectors*, J. S. H., W. T. H., M. T. C., C. F. B.

Aspidiotus cocotiphagus Mar.

Hosts, Cycas revoluta, Coconut, Phœnix Palm, Palm, Citrus trifoliata, Honeysuckle, Anone, Royal Palm. *Localities*, Jardin

Botanica de la Universidad de Habana, (Habana), Santiago de las Vegas, Jardin Botanica del Segundo Ensenanda de Habana, Habana). Santiago de Cuba. *Dates*, Jan. 27, 1909; June 4, 1908; Aug., 1904; Feb. 2, 1909; July 20, 1908; Sept. 24, 1907; May 13, 1908; Nov. 16, 1908. *Collectors*, J. S. H., W. T. H., S. P. S.

Aspidiotus subsimilis var **anonæ** n. vr.

Hosts, Milliflores verbenacia, Cinnamonicum zeylanicum Breyn, Maclura tinctoria Don., Rose, Spondias purpurea, Lonchocarpus latifolius Kth., Magnolia grandiflora, Faberna. (Anona sp., Mangifera cambodiana and Loquat—Records of Dr. C. L. Marlatt, Bur. Ent. U. S. D. A. See note following description.) *Localities*, Jardin Botanica de la Universidad de Habana (Habana), Jardin Botanica del Instituto Segunda Ensenada de la Habana (Habana). *Dates*, 1907; Jan. 27, 1909; Feb. 21, 1909; 1910. *Collectors*, J. S. H., W. T. H., (E. R. Sasscer. See note following description.)

Description.—Scale of Female: 1 to 1.9 mm. in diameter; irregularly circular; thin; tough; slightly convex; very inconspicuous, due in part to the fact that the insect is partly mining in its habit as particles of thin bark usually extend over the scale; dorsal shed skin conspicuous; located on bark of host; no dot and ring present. Scale of Male: Not known. Adult Female: Length ranges from 0.8 mm. to 1 mm. and width from 0.8 mm. to 1.1 mm., usually wider than long, type specimen 1 mm. wide, 1.12 mm. long, yellow, of usual form, circumgenital pores wanting. Nearest *A. subsimilis* Ckll. and *A. coursetiæ* Mar. Anal Plate: In shape rather sharply triangular, retracted within the scale body, two broad chitinized areas extending from the posterior tip well up into the pygidium where they gradually disperse. One pair of lobes placed close together, broader at base, usually notched on both sides near the tip, tip rounded; chitinized processes equal to two-fifths the length of the lobe extending up into the pygidium from the mesal portion of the base of each lobe and from the opposite of each lobe is a similar process but lacking a little of being half as long as the preceding. Incisions between median lobes shallow, second and third incisions shallow also; lateral margins of second and third incisions bordered by strongly chitinized thickened processes; mesal process of second incision greatly elongated and abruptly terminating in a globular swelling or club; lateral processes about one-third as long and only slightly swollen; chitinous processes of third incision sub-equal, slightly swollen anteriorally and both usually curved laterad. Plates small, simple, inconspicuous, one arising from each side of the mouth of the second incision, two mesad and two laterad of the third incision; of the two last mentioned the outer one is very weak and slender; two or three additional plates on the pygidial margin. Spines strong, prominent; a single spine laterad of each of the lobes, two laterad of each of the second and third incisions and two about midway of the pygidial margin. Anal opening slightly caudad of the knobs of the chitinous processes of the second incisions, about two-thirds as large as a single knob. Genital opening about nine times the length of the lobes above them. Three rows of dorsal pores of from seven to nine pores each, extending up into the pygidium at an acute angle to the pygidial margin.

Note.—It was the original intention of the writer to describe this as a new species; indeed, this was done in manuscript form as it appears above. In December, 1916, Dr. Marlatt kindly granted him access to the Coccid collection of the Bureau of Entomology, and during this study it developed that an identical species was known under the manuscript name of *A. subsimilis* var. *anonæ* in the Bureau's collection. Upon learning of the writer's material, Dr. Marlatt generously insisted that their material be included with his and published. The collection records of the Bureau's material were:

1. On Anone sp. Lima, Peru, 1909, E. R. Sasscer.
2. On Mangifera acambodiana, Miami, Fla., 1910, E. R. Sasscer.
3. On Loquat, Miami, Fla., 1910, E. R. Sasscer.

The following are Dr. Marlatt's manuscript notes:

"*Aspidiotus subsimilis* Ckll. Is very closely allied to *coursetiæ* sp. nov., the latter perhaps not deserving more than varietal rank. It is readily distinguished from the *ancylus* group of species, to which it is closely allied, by the elongated and knobbed character of the inner chitinous thickening or paraphysis of the first incision, resembling in this respect somewhat *Aspidiotus ulmi* Johnson.

"Some material showing a slight divergence from the type was collected in the Department greenhouses by Mr. Sasscer on *Anona* sp. imported from Lima, Peru. This form is more chitinized than the type material of *subsimilis*, the knobbed paraphyses are a little longer, and the anal orifice a little more remote from tip. When a larger acquaintance with *subsimilis* is gained by future collections and study, this variety will very probably be found to fall within the variation of the species. For the present, however, it may be designated as *subsimilis* var. *anonæ*."

Type and paratypes in the collection of the Bureau of Entomology U. S., Department of Agriculture, Washington, D. C. Entomology, U. S. Paratypes and cotypes in writer's collection.

Aspidiotus cyanophylli Sign.

Hosts, Rose, Psidium guiava, Anone. *Locality*, Santiago de las Vegas. *Dates*, Oct. 10, 1906; Oct. 11, 1908; Sept. 18, 1907. *Collectors*, W. T. H., J. S. H.

Aspidiotus destructor Sign.

Host, Coconut. *Locality*, Santiago de las Vegas. *Date*, August, 1904. *Collector*, W. T. H.

Aspidiotus fabernii n. sp.

Host, Faberna. *Locality*, Jardin Botanica del Instituto Segunda Ensenada de la Habana (Habana). *Date*, Jan. 27, 1909. *Collector*, J. S. H.

Description.—Scale of Female: 1.25 mm. in diameter, strongly convex, usually circular though sometimes slightly elongate; exuviæ central, covered, but the granular covering easily rubbed off, leaving exposed the yellow or orange exuviæ; ventral scale white, conspicuous; the scales are piled one upon another giving the bark the appearance of bearing scattered nodules. Adult Female: About 1 mm. long and 0.93 mm. wide; pygidium broadly triangular; three pairs of lobes, median broader than long, prominent, lateral margin usually entire though sometimes notched, apices rounded, nearly touching; second pair of lobes slightly less than half as broad and long as median, usually entire though sometimes notched apically; third pair of lobes small, pointed, inconspicuous, usually a rudimentary fourth lobe and if so, low and rounded; second and third incisions with thickened edges; chitinized median portion of each incision longer and stouter than the lateral portion; a very minute plate between the first and second and two between the second and third pairs of lobes; on the pygidial margin laterad of the third pair of lobes are five prominent bifurcate pectinæ strongly swollen at the base and usually a simple plate; counting laterad the first three pectinæ are similar, equidistant and are between the third and rudimentary fourth lobes; the fourth and fifth pectinæ are slightly smaller than the first three and are located laterad of the rudimentary fourth lobes; the bifurcate pectinæ are very characteristic, being greatly broadened at the base and the points of the fork usually diverge strongly, but sometimes both curve mesad; the remaining simple plate is located on the pygidial margin at a distance from the fifth pectina a little greater than that between the third and fourth pectinæ; it has the same swollen base characteristic of the pectinæ but it is not bifurcate at the tip; there is a dorsal and a ventral spine laterad of each pair of lobes including the rudimentary fourth and one about the middle of the pygidial margin; the spines laterad of the median lobes are weak and subequal in length to the median lobes; the spines of the second, third and fourth positions increase gradually in size until they attain a length equal to twice that of the pectinæ; the spines of the fifth position are about equal to those of the second; the anal opening is four or five times its own width cephalad of the base of the median lobes and the vaginal opening is nearly twice this distance cephalad of the base of the lobes; circumgenital pores are wanting.

Relationship.—This species is nearest *A. diffinis* but differs from it particularly in the number, shape and position of the pectinæ and the number and size of the spines as well as in other characters. Type and paratypes in the collection of the Bureau of Entomology, U. S. Department of Agriculture, Washington, D. C. Paratypes in writer's collection.

Aspidiotus hederæ (Vall).

Hosts, Anone, Magnolia grandiflora, Pandano utes H. de G., Guava, Coconut, Manoca Palm, Citrus trifoliata, Avocado (leaf). *Localities*, Santiago de las Vegas, Jardin Botanica de la Universidad de Habana (Habana), Baracoa. *Dates*, Oct. 23, 1908; Jan. 27, 1909; Feb. 27, 1907; May 14, 1907; March 17, 1907; Sept. 18, 1907; Oct. 16, 1907; Nov. 13, 1906; Oct. 19, 1907; Feb. 19, 1909; Sept. 27, 1907. *Collectors*, J. S. H., W. T. H.

Aspidiotus lataniæ Sign.

Hosts, Peach, Milliflores verbenacia, Lupiter, Cinnamomum zeylanicum Breyn, Salix Bablyonica L., Laurel de Espana, Ficus carica L., Citrus sp., Enterolobium cyclocarpum (Sw) Gr., Antigonum leptopus Hed., Cultivated fig, Cherry, Wild Legume, Clerodendron fragrans L., Wild Guava, Dricina terminalis, Coconut, Hibiscus, Yucca gloriosa, Small honeysuckle, Satlfergia sissoa, Loguat, Avocado, Lonchocarpus latifolius Kth. Spomea purpurea Lam. *Localities*, Santiago de las Vegas, Jardin Botanica de la Universidad de Habana (Habana), Jardin Botanica del Segundo Ensenada de Cuba (Habana), San Cristobal, San Antonio de las Banas. *Dates*, Jan. 31, 1909; Jan. 27, 1909; Feb. 2, 1909; Oct. 10, 1907; Dec., 1906; June 12, 1908; July 22, 1908; May 12, 1906; Oct. 15, 1906; Oct. 11, 1908; July 29, 1908; Oct. 23, 1908; July 29, 1908; Oct. 10, 1906; Sept. 24, 1907; June 13, 1908; Feb. 16, 1909; Feb. 11, 1909; Feb. 8, 1909; June 16, 1906. Collectors, J. S. H., W. T. H. E. W. H.

Notes.—It is generally considered that *A. latanicæ* has one air of lobes, but in the greater part of this material the second nd third pairs are developed into sharply pointed, small tringular processes which it seems should be called lobes. Accordng to various descriptions there should be plates between the median pair of lobes, and these specimens agree for the most art in this respect, but some have one pectina and one plate in his position, while others have two pectinæ. The number of ircumgenital pores also seems quite variable. Most of this material in this respect runs below the numbers usually attributed to this species.

Aspidiotus palme Morg and Ckll.

Host, Magnolia grandiflora. *Locality*, Jardin Botanica de la niversidad de Habana. *Date*, Jan. 27, 1909. *Collector*, J. S. H.

Aspidiotus sacchari Ckll.

Hosts, Panicum molle, Coix lacryma L. *Localities*, Banes, ardin Botanica del Instituto Segunda Ensenada de la Habana Habana). *Dates*, Aug. 23, 1907; Feb. 2, 1909. *Collectors*, V. T. H., J. S. H.

Aspidiotus spinosus Comst.

Hosts, Cinnamomum zeylanicum Breyn. *Locality*, Jardin Botanica del Segundo Ensenada de Cuba. *Date*, Jan. 27, 1909. *Collector*, J. S. H.

Pseudaonidia tesserata (de Charm).

Hosts, "Ciduela," Leucæna glauca Beuth. *Localities*, Saniago de las Vegas, Jardin Botanica del Instituto Segunda Ensenada de la Habana (Habana). *Dates*, Jan. 27, 1909; Feb. 8, 1909. *Collector*, J. S. H. *Note.*—In de Charmoy's descripion, (Pro. Societie Amicale Scientifique de Mauritius, 1889, p. 23), he states that the second pair of lobes is shorter than the third, while in this material the third is shorter than the second.

Selenaspidus articulatus (Morg).

Hosts, Phœnix dactylifera L., Lime, Orange, Small White Honeysuckle, Bergamota, Sweet Orange, French Mandarin, Lemon, Sour Sop, Palm, Laurel nobilis, Maclura tinctoria Don., mone, Satsuma Orange, Tangerine, Grape Fruit, Muchlenbeckia platyctoda M., Calophyllum calaba Jacq., Laurel de la India, "Sidra" (Citrus sp), Magnolia grandiflora, Caymito.

Localities, Jardin Botanica de la Habana (Habana), Ciego d'Avila, Santiago de las Vegas, Cristo, Bahia Honda, Sætia, Jardin Botanica del Segunda Ensenada de la Habana (Habana). *Dates*, Jan. 27, 1909; Sept. 7, 1905; Sept. 13, 1905; Sept. 5, 1905; Jan. 13, 1906; Feb. 2, 1908; Jan. 12, 1908; May 5, 1907; July 22, 1908; Sept. 24, 1907. *Collectors*, J. S. H., W. T. H., W. A. P., E. W. H.

Chrysomphalus aonidum Lin.

Hosts, Cycas revoluta, Grape fruit, Lime, Rose, Orange, Sour Orange, Sweet Orange, Citrus sp., Lemon, Coconut, Bergamonta, Zamia pumila, Dracinia terminalis, Martinezia caryotæfolia Hg. B., Anone, "Hennequin," Citrus trifoliata, Ficus religiosa, Mammea, americana, Colophyllum coloba Jacq., Citrus decumana Lin., "Laurel de la Yndia," "Sidra," Magnolia grandiflora Lin., Pandano utes H. de G. *Localities*, Jardin Botanica de la Universidad de la Habana (Habana), Santiago de las Vegas, Ciego D' Avila, Alquizar, Guantanamo, Mazorra, Mariel, Consolacion del Sur, Jardin Botanica del Instituto Segunda Ensenada de la Habana (Habana), Ladd Farm Santiago de las Vegas. *Dates*, Jan. 27, 1909; July 21, 1908; Sept. 7, 1905; Dec. 3, 1905; Oct. 15, 1906; July 27, 1906; Feb. 9, 1905; Dec. 11, 1905; Dec. 3, 1904; Feb. 10, 1905; July 18, 1904; Sept. 7, 1905; Feb. 19, 1905; Sept. 13, 1905; Nov. 3, 1905; Oct. 11, 1908; Feb. 2, 1909; Dec. 1, 1901; July 10, 1908; Feb. 16, 1909. *Collectors*, J. S. H., W. T. H.

Aonidiella calurus (Ckll).

Hosts, Calapenæ (Sydney), Mammea americana. *Localities*, Santiago de las Vegas, Jardin Botanica del Instituto Segunda Ensenada de la Habana (Habana). *Dates*, Feb. 16, 1909; Feb. 2, 1909. *Collector*, J. S. H.

Chrysomphalus dictyospermi (Morg).

Hosts, Misparo, Citrus sp., Cinnamomum zeylanicum Breyn., Melicocca bijuga L., Avocado, Rose, Royal palm, Mango, "Ciduella." *Localities*, Jardin Botanica de la Universidad de Habana (Habana), Jardin Botanica del Instituto Segunda Ensenada de la Habana (Habana), Santiago de las Vegas, Santiago de Cuba. *Dates*, Jan. 27, 1909; May 22, 1908; Oct. 17, 1907; July 21, 1908; Sept. 24, 1907; April 22, 1908; July 20, 1908; Nov. 16, 1908; Sept. 24, 1907; Feb. 8, 1909; Feb.

18, 1909. *Collectors*, J. S. H., W. T. H. *Note.*—This is quite a variable species, the principal point of variation being in the so-called "candle-flame" like projections on the pectinæ.

Pseudischnaspis alienus (Newstead).

Hosts, Milliflores verbenacia, Cassia obtusifolia L., Salix Bablionica L., Grevillea robusta, Yucca gloriosa, Clerodendron, Muehlenbeckia platyclada M., Rose. *Localities*, Jardin Botanica de la Universidad de Habana (Habana), Jardin Botanica del Instituto Segunda Ensenada de la Habana (Habana), Santiago de las Vegas. *Dates*, Jan. 27, 1909; Oct. 11, 1908; Feb. 2, 1909. *Collector*, J. S. H.

Odonaspis secreta (Ckll).

Host, Paral grass. *Locality*, Aquacati. *Date*, Dec. 16, 1908. *Collector*, J. S. H. *Note.*—These specimens agree well with the description of *O. secreta* excepting as to the arrangement of the circumgenital pores. In these specimens the anterior laterals are joined by a large median group thus forming an almost perfect horseshoe. In this respect they correspond with Maskell's relegated variety *lobulatus*.

Pseudoparlatoria parlatorioides Comst.

Hosts, Carica papaya, Acalyphia tricolor Hartul, "Sidra" (Citrus sp.). *Localities*, Santiago de las Vegas, Jardin Botanica del Instituto Segunda Ensenada de la Habana (Habana), Jardin Botanica de la Universidad de Habana (Habana). *Dates*, Oct. 29, 1906; Feb. 2, 1909; Jan. 27, 1909. *Collectors*, W. T. H., J. S. H. *Note.*—These specimens have three to eight median circumgenital pores, thus disagreeing with Comstock's description. Comstock's types have no pores in this position. The fishtail is a little more pronounced in Comstock's material than in this.

Lepidosaphes beckii (Newm).

Hosts, Citrus sp., Grape Fruit, Orange, Lemon, Tangerine, Tangerine Fruit, Passion Vine, Citrus trifoliata, Citurs decumana L., "Sidra" (Citrus sp.), Guava, Avocado. *Localities*, Jardin Botanica de la Universidad de Habana (Habana). Pinar del Rio, Santiago del las Vegas, Artemesia, San Cristobal, Rincon, Ceballos, Sætia, Bahia Honda, Alquizar, Banes, Mazorra, Mariel, Consolacion del Sur, Jardin Botanica del Instituto Segundo Ensenada de Cuba (Habana). Taco Taco, Baracoa. *Dates*, Jan. 27, 1909; Dec. 7, 1904; Aug. 26, 1905; Feb. 6, 1906; Nov. 8, 1905; Aug. 4, 1904; Sept. 7, 1905; March 6, 1906; March 5, 1907; July 18, 1904; March 2, 1906; Feb. 14, 1906; Nov. 26, 1905; Sept. 7, 1905; Dec. 3, 1905; Oct. 10, 1907; March, 1906; Feb. 9, 1905; April 14, 1905; Dec. 3, 1904; Feb. 10, 1905; Feb. 19, 1905; Nov. 3, 1905; June 3, 1907; March 22, 1905; Sept. 27, 1907; July 20, 1908; Feb. 2, 1909; July 21, 1908. *Collectors*, J. S. H., M. T. C., W. T. H. *Note.*—Although this species is undoubtedly the true *L. beckii* (Newm), a number of variations have been found which may be worthy of note. In Newstead's description (Monograph of the British Coccidæ, Vol. I, p. 204), he records from five to seven pores of the median group of the circumgenitals and these are in a single concave series. One specimen, No. 186, has only three median pores grouped—not in a single concave series. One specimen, No. 262, has only six pores of the posterior lateral group, disagreeing with Newstead who reports seven to eleven.

Lepidosaphes flava hawaiiensis (Mask).

Host, Malpighia punicifolia L. *Locality*, Jardin Botanica de la Universidad de la Habana (Habana). *Date*, Jan. 27, 1909. *Collector*, J. S. H.

Lepidosaphes gloverii (Pack).

Hosts, Tangerine, Grape Fruit, Citrus sp., Lemon, "Lemoncelli." *Localities*, Ceballos, Santiago de las Vegas, San Cristobal, Taco Taco, Jardin de la Universidad de Habana (Habana) Sætia. *Dates*, March 6, 1906; July 18, 1904; March 2, 1906 Feb. 14, 1906; Nov. 8, 1906; Sept. 7, 1905; Nov. 22, 1905 Jan. 27, 1909; March 1, 1909. *Collectors*, W. T. H., J. S. H.

Ischnaspis longirostris (Sign).

Hosts, Royal palm, Honeysuckle. *Locality*, Santiago de las Vegas. *Date*, Sept. 24, 1907. *Collector*, W. T. H.

Parlatoria pergandii Comst.

Hosts, Citrus sp., Grape Fruit, Tangerine Fruit, Orange. *Localities*, Taco Taco, Sætia, Santiago de las Vegas. *Dates*, Nov. 22, 1905; Sept. 7, 1905; Feb. 11, 1909; Feb. 14, 1906. *Collectors*, W. T. H., J. S. H. *Note.*—This material agrees closely with Comstock's description and figure, (Report of the United States Department of Agriculture, 1880, p. 227), with the exception that the specimens have a seta upon both the ventral and lateral aspects of the median pair of lobes, whereas Comstock gives one on the dorsum only. The material at hand has well-developed pectinæ laterad of the fifth pair of lobes and these are not shown perfectly in Comstock's figure. Newstead (Pl. XXXII, Fig. 2, Monograph of the British Coccidæ), illustrates the fourth lobe as trifurcate. This is believed to be an error.

SPECIES OF *Conchaspis* Ckll.

A. Antennæ of adult female with six segments..............*C. Newsteadi* Ckll.

AA. Antennæ of adult female with less than six segments.

B. Antennæ of adult female with five segments..*C. fluminensis* Hemp.

BB. Antennæ of adult with less than five segments.

C. Antennæ of adult female with four segments, body gradually narrowed caudad of thorax.

D. Body of adult female purplish red, scale conical with apex normal..............................*C. angræci* Ckll.

DD. Body of adult female colorless, except the brown pygidium, scale conical, apex to one side..*C. angræci hibisci* Ckll.

CC. Antennæ of adult female with three segments, body abruptly narrowed caudad of the thorax.............*C. socialis* Green.

SPECIES OF *Pseudischnaspis* Hemp.

A. Large dorsal gland orifices of each side in two rows running parallel with the pygidial margin. Club shaped paraphyses in five pairs, the first pair small, arising from the inner margin of the median pair of lobes, four large ones beyond.

B. Circumgenital pores in four groups, anterior laterals of seven each and posterior laterals of eight each. Five distinct serrations and some indistinct ones lateral of the third pair of lobes..*P. bowreyi* (Ckll).

BB. Circumgenital pores in five groups, median two anterior laterals five and posterior laterals three. Three distinct serrations laterad of the third pair of lobes..........................*P. longissima* (Ckll).

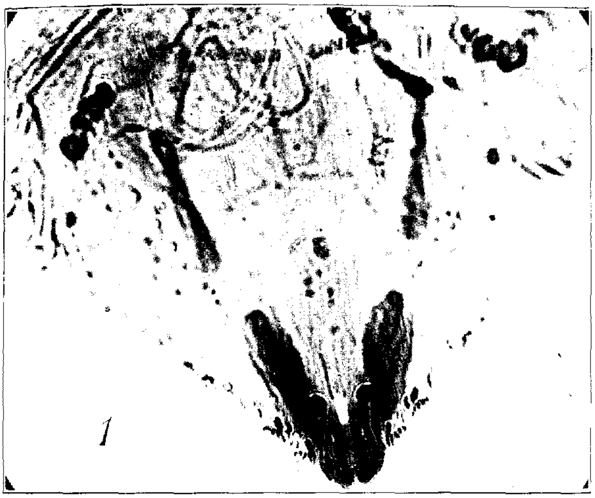
AA. Large dorsal gland orifices of each side not arranged in two rows running parallel with the pygidial margin. Paraphyses in six pairs.

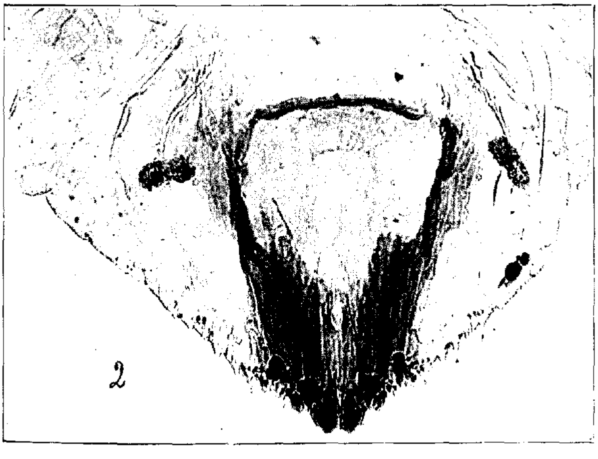
B. A single bifurcate plate in each of the incisions, one laterad of the third pair of lobes and two simple plates on the pygidial margin. Tips of bifurcate plates recurved and points rounded. Second, fifth and sixth pairs of paraphyses longest. First, third and fourth pairs less than one-half the length of the others.........*P. alienus* (Newst).

BB. A single bifurcate plate between the median pairs of lobes, two trifurcate plates in the second and third incisions and a trifurcate plate laterad of the third lobe. No plates on pygidial margin. Bifurcate and trifurcate plates with points triangular and tips acute. Second and fifth pairs of paraphyses longest, fourth and sixth about two-thirds their length, and first and third less than one-half the length of the longest......................................*P. linearis* Hemp.

EXPLANATION OF PLATE XVIII.

1. Anal plate of Aspidiotus subsimilis var. anonæ n. var. Greatly enlarged (original).
2. Anal plate of Aspidotus farbernii n. sp. Greatly enlarged (photograph by E. R. Sasscer).





J. S. Houser

AN INTERESTING HABIT OF A WAX MOTH PARASITE.[*]

By S. A. Graham,
Assistant in Division of Economic Zoology, Minnesota State Experiment Station.

INTRODUCTION.

During the fall of 1916, while rearing the bee moth, *Galleria mellonella* in the insectary for experimental purposes, a Pteromalid parasite *Dibrachys clisiocampæ* Fitch[†] was observed to be very common about the breeding cages. Further investigation disclosed the fact that these parasites were emerging from the cocoons of the bee moth. They were so abundant that very few of the larvæ of the host were able to pupate and come to maturity. This is interesting inasmuch as previous records of the parasite[‡] give the host as the forest tent caterpillar, *Malacosoma disstria.*

During March these same parasites were emerging in such numbers from nucleus hives stored in the laboratory of the Bee Division that the windows of the room were literally covered with the small black insects.

Insofar as can be ascertained from the literature at hand, this parasite has never been recorded as attacking the bee moth, nor has its complete life history been described. This being the case and considering the possible value of this parasite in checking the ravages of the bee moth in stored combs, it was deemed advisable to keep the insect under observation during the winter and to determine as fully as possible its life history and habits.

LIFE HISTORY.

The host is attacked after spinning the cocoon, usually while still in the larval stage, but occasionally the pupa, while still soft and white, may be attacked. The female parasites walk rapidly over the cocoons feeling the surface with their antennæ. When a suitable place is found the caudal end of the

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[*] Published with the approval of the Director as Paper No. 82, of the Journal Series of the Minnesota Agricultural Experiment Station.

[†] For the identification, I am indebted to Mr. A. J. Girault, formerly of the National Museum, Washington, D. C.

[‡] Fitch—2d Report on Noxious, Beneficial and other Insects of the State of New York, page 432.

body is drawn forward until the abdomen is in a vertical position. The ovipositor is then inserted into the cocoon after which the abdomen again assumes its normal position and the ovipositor sheath slips into its place in the groove on the ventral side leaving only the ovipositor proper in a vertical position. At the same time the ventral segments are extended downward and forward, forming a triangular piece below the abdomen from the vertex of which the ovipositor extends. In removing the ovipositor this operation is reversed.

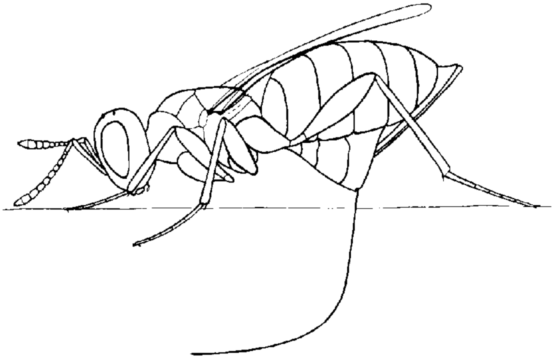

FIG. 1. Female *Dibrachys clisiocampæ* Fitch in position of oviposition.

As soon as the ovipositor is thrust into the cocoon the larva within becomes excited and moves about in an effort to get out of the way. The parasite thrusts its ovipositor into the larva, but does not deposit any eggs. It may stab it several times in different places before removing the ovipositor from the cocoon but no eggs are deposited until the larva within the cocoon is quiescent. This operation is repeated over and over again by the parasite as she walks from cocoon to cocoon, always stabbing the active larva with her ovipositor but never ovipositing in it. In from 6 to 24 hours the larvæ thus stabbed become sluggish and finally die.

When the parasite inserts her ovipositor and the larva remains quiet, she deposits her eggs on the surface of the body, usually in wrinkles in the skin. Usually two or three eggs are deposited in a place but often they are placed singly. The ovipositor can be bent in any direction and the egg after being forced almost entirely out, can be held by the tip and placed in the proper position, and then released. The eggs are not fastened, but lie loosely in the folds of the skin of the host.

The eggs hatch in from 3 to 7 days and the young parasites immediately fasten themselves to the body of the host and begin to feed. The length of the larval stage was found to be rather variable, lasting from two to four weeks or even longer. Without exception, the moth larva was attacked by bacteria and reduced, before the parasite larvæ completed their growth, to a putrescent semi-liquid state, held together only by the skin of the host.

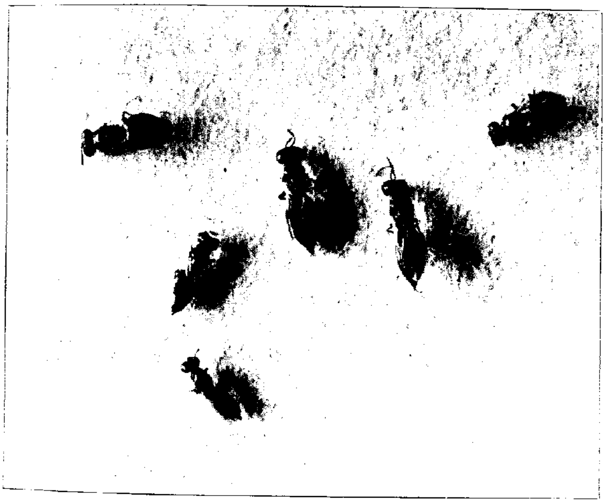

FIG. 2. Adults of *Dibrachys clisiocampæ* Fitch.

The pupal stage required from 14 to 25 days for its completion. Thus the life cycle from egg to adult varied from 31 to 59 days. The longest period occurred during mid winter when the temperature in the insectary often fell as low as 60° at night.

The adults feed readily upon sweetened water and under natural conditions, honey or nectar probably makes up a large part of their diet. The females were observed to puncture dead larvæ with the ovipositor and carefully draw up parts of the body tissue to the surface of the cocoon and then feed upon it.

HOST KILLED BEFORE OVIPOSITION OF PARASITE.

The one point in this life history which seems to be of unusual interest and perhaps practical importance is the fact that the parasite stings the host before depositing eggs upon it and oviposits only on dead or inactive larvæ.

The question naturally arose as to whether the larvæ were killed by the parasite or died from other causes.

Larvæ which had just died were examined by C. W. Howard of this Division, who was unable to find any indication that the caterpillars were killed by disease. After the larvæ had been dead one or two days, small brown spots appeared on the skin presumably at the points pierced by the ovipositor. These spots rapidly increased in size.

Larvæ, after being stung, but while still alive and active, were injected with a 1% solution of trypan blue and after about an hour were opened and the stain washed out. On examination, the skin and tissues immediately surrounding each puncture made by the ovipositor were found to be stained blue. Larvæ which had never been stung when injected in a similar manner, showed no such stained areas. It was thus possible to determine the number of times a larva had been stung by the parasite. The number of punctures in a single larva ranged from 6 to 38. There seems, therefore, to be no doubt that the parasite actually stings the larva.

In order to prove that this stinging kills the larvæ of the wax moth, forty healthy larvæ were placed in a glass jar containing no parasites. They spun their cocoons and at the end of three days were all perfectly normal. Then twenty of these were removed from their cocoons and placed in another similar jar where they again spun cocoons. Thirty parasites were then introduced into the first jar where the larvæ had been undisturbed, since spinning their cocoons. These parasites were observed to move actively about and sting the larvæ. In less than a week every larva in this jar was dead. The larvæ in the second jar were all alive and eventually eighteen out of the twenty reached maturity. This experiment was repeated three times with similar results in each case. This experiment showed that the larvæ were undoubtedly killed by the sting of the parasite, but whether death was the result of mechanical injury or of a poison injected by the parasite was the subject of further investigation.

A series of healthy larvæ were selected and each was pierced deeply with a minuten pin from one to twenty-five times. In spite of the fact that all stabbed in this way lost considerable blood and many were weak after the operation, every one recovered. Since the minuten pin was longer and thicker than the ovipositor of the parasite, this experiment indicates that the larvæ were not killed by mechanical injury, but that some poisonous material must be injected to cause their death.

Packard* refers to Bordas as authority for the statement that poison glands connected with the ovipositor may be safely said to be of general occurrence in the Hymenoptera. Dissection shows the presence of an organ which may be a poison gland but, as yet, this point has not been definitely determined.

Although apparently not mentioned in literature, this habit of killing the host before oviposition may be common to many of the ectoparasites of the superfamily Chalcidoidea. In support of this supposition it may be stated that the author has observed that the larvæ of the white pine weevil, *Pissodes strobi*, Peck, are always found to be dead when larvæ of the Chalcidid parasite *Eurytoma pissodis* Gir., are found upon them. The oviposition of this species has not as yet been observed. Marcovitch,† while working with parasites of the strawberry weevil, *Anthonomus signatus* Say, never found the eggs of certain Chalcidoid parasites on any but dead weevil larvæ, but on the other hand, found many weevil larvæ dead or dying without any apparent cause. These observations indicate the existence of a similar condition to that found in this parasite of the wax moth. The killing of the host before ovipositing is a decided advantage to such an ectoparasite since it insures the safety of the eggs and larvæ from injury due to movements of the host within the cocoon.

Dibrachys chlisiocampæ and possibly others of the same group apparently form the connecting link between the scavangers and the parasites since the larvæ feed entirely on dead and decaying material killed by the parent.

Since the dead larvæ on which these parasites feed are in a state of decomposition and continually changing chemically and physically during the feeding period, it is possible that under the proper conditions, such parasites could be fed upon some animal material other than insect larvæ. This would make it possible to rear parasites on a scale large enough to be of practical importance in the control of some insect pests, inasmuch as one of the greatest difficulties in the raising of parasites, lies in the problem of providing a sufficient amount of suitable food.

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* Packard, 1909, A Text Book of Entomology, page 358.

† Marcovitch, 1916, The Strawberry Weevil in Minnesota. Sixteenth Report of the State Entomologist of Minnesota for 1915 and 1916, page 122.

SUMMARY.

1. *Dibrachys clisiocampæ* Fitch, is parasitic upon the larvæ and pupæ of the wax moth and should be a valuable parasite in controlling the wax moth in stored combs.
2. The length of life cycle is rather variable requiring from 31 to 59 days for completion.
3. The female parasite stings and kills the host before ovipositing.
4. It may be possible to rear these and other valuable ectoparasites on some food, other than their natural host.

EXPLANATION OF PLATE XIX.

FIG. 1. Eggs of *Dibrachys clisiocampæ* on a pupa of the wax moth.
FIG. 2. Larvæ and eggs of *Dibrachys clisiocampæ* Fitch upon larva of wax moth.
FIG. 3. Young larvæ of *Dibrachys clisiocampæ* Fitch on wax moth larva.
Fig. 4. Pupæ of *Dibrachys clisiocampæ* Fitch upon a wax moth larva.

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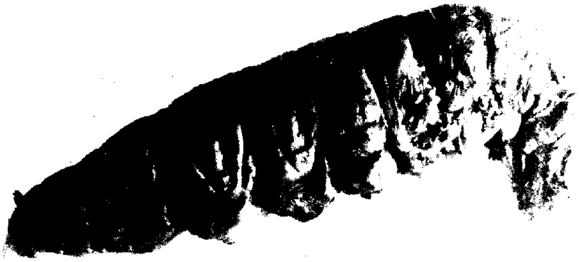

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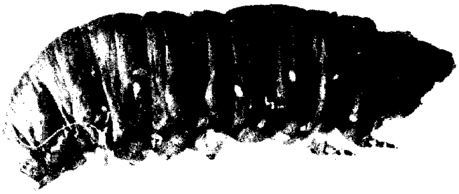

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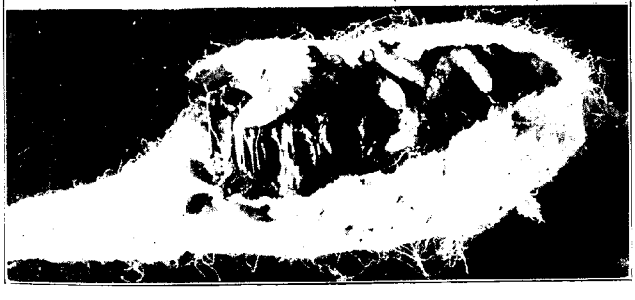

S. A. *Graham*

THE DIPTEROUS GENUS DRAPETIS MEIGEN (Family Empididæ).*

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The species of Drapetis are to be distinguished from the remainder of the Empididæ by the following summarized combination of characters. Thorax robust, the humeri not swollen and constricted. Eyes closely approximate on the face, but on the front diverging above; palpi broad, incumbent on the very short proboscis; antennæ three-jointed, with terminal or subterminal arista; one pair each of vertical and ocellar bristles. Legs hairy and often furnished with bristles or setæ, the middle femora however rarely armed and not thicker than the front pair. First basal cell of the wings shorter than the second which is united with the discal cell, anal cell completely wanting, only two posterior cells before the anal area.

The genus Drapetis includes very small flies, among the smallest of all the Diptera, which are found during the spring and summer, sometimes swarming about flowers like wild cherry and plum, and sometimes running about singly over grass and low shrubbery. Their early stages are quite unknown. In the tropics slender yellow-colored species predominate but in the Temperate Zone the general species are black and more robust.

In the following pages are given a detailed discussion of the external morphology of the drapetine flies, a synoptic table to the fifty-five North American forms, descriptions of forty-two new species and varieties, and a complete bibliography to the genus and to the 133 described species and varieties at present known from the whole world, including four fossil species. The writer's personal collection contains sixty-seven of the named species and varieties, of which forty-six species are represented by type material. In addition he has studied Coquillett's types at the National Museum and Loew's types at the Museum of Comparative Zoology.

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* Contribution from the entomological laboratories of the Bussey Institution for Applied Biology, Harvard University. No. 149.

During the year 1899, while a student at the University of Texas the writer began a study of the Empididæ, a family of predatory dipterous flies. Since that time several papers dealing with the taxonomy of the family have appeared from his pen, notably a review of the North American species known up to 1902, which was published as a thesis for the master's degree. The accumulation of a wealth of material in this family, especially from the rich collecting fields of the Pacific North-west, led to the preparation of an exhaustive review of the group which was accepted by Harvard University in 1914 as the thesis requirement for the degree of Doctor of Science. It was the writer's intention to issue this manuscript of quite one thousand pages in the Genera Insectorum, but the outbreak and centralization of the war in Belgium entirely precluded this possibility. Since many of the new species have been distributed among museums and individual collections it seems desirable to have their names published. The following pages, dealing with the single genus Drapetis, have been excerpted as the first presentation of the dismembered dissertation.

Etymologically the name *Drapetis* comes from the Greek word *Drapetis*, meaning a runaway. Since the penult is formed with the short vowel epsilon the accent in English pronunciation falls on the first syllable, *i. e.*, Drap-e-tis.

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GENERAL MORPHOLOGY.

Head globular, sometimes slightly longer than high, the occiput more or less hemispherical; eyes large, bare, at most with scattered microscopic hairs, the facets of uniform size, beneath the antennæ the eyes of both sexes nearly touching, leaving the face linear or very narrow, above the eyes the front is V-shaped, always broader than the face, sometimes the front is quite narrow; three small ocelli present. Excision of the eyes at the level of the antennæ very large; cheeks sometimes entirely obliterated, usually about one-eighth the height of the eye, with the oral margin obliquely descending posteriorly. Proboscis thick, rather sharply pointed, perpendicular or directed backward, averaging one-half the height of the head, its labrum with prominent base and as long as the labium; palpi broadly oval, one-jointed, applied to the proboscis, the inside glabrous and shining, the outside pollinose and with more or less evident recumbent pubescence, generally tipped with a longer seta. Antennæ inserted close together a little above the middle of the head, three-jointed, very rarely the basal joint is wanting, the second joint with a circle of small setulæ, the bottom hair of which is sometimes long, the third joint compressed, varying from short oval, not longer than deep and with subterminal arista to lanceolate or conical, nearly twice as long as deep and with terminal arista; the arista usually slender, nearly bare, two-jointed, its basal joint small, its outer joint two or three times as long as the antennæ, rarely the hairy coating is dense and longer so as to give a thickened appearance to the arista. Occiput often with a pollinose band on the lower orbits including the cheeks excepting their lower margin, usually with sparse short hairs, typically a pair of ocellar and one of vertical bristles present, rarely two or three pairs of vertical and an additional pair of post-vertical bristles present, sometimes an oral bristle on the back part of the cheeks.

Thorax robust, polished, nearly bare to pubescent, dorsocentral bristles usually limited to a pair of prescutellars, humeral and posthumeral bristles present or absent, notopleural bristles present but variable, scutellum with two or four marginal bristles, the lateral ones always shorter; pleuræ bare, rarely with pollinose streaks following the sutures. Abdomen with eight segments, the first segment laterally inflated, the fourth segment usually large and more heavily chitinized than the others, its sides often pollinose and bearing scimiter-shaped, glistening setulæ, the fifth segment short; pygidium varying from small to large, closed to widely open, asymmetrical, the right side usually with a broad, curved, furcate valve. Legs rather stout, the front femora a little the strongest, usually the anterior femora with a basal flexor hair and with a preapical bristle on the outer side, the hind femora with one to three preapical bristles on the anterior face, hind tibiæ with extensor bristles and more or less produced as an apical tooth-like spur, the anterior tibiæ with a pair of apical bristles; sometimes the legs are devoid of all bristles; pulvilli broad; in those species with broad tibial spur the inside of the hind metatarsi and of the end of the hind tibiæ spongy pubescent.

Wings with anal angle more or less developed, except very rarely the first basal cell shorter than the second which is always fused with the discal cell, five simple longitudinal veins, anal cell completely wanting, at most a short trace of the anal vein present toward the hind margin but the anal cross-vein always lacking, usually the entire margin of the wing uniformly short-ciliate, sometimes the hairs of the first section of the costa are longer, no stigma and no definite color pattern.

The species of *Drapetis* are included in the following subgenera:

1. *Drapetis* Meigen, sens. str. Type species, *exilis* Meigen. Rather small, bristleless, black species, with short antennæ directed somewhat upward, the second joint without a conspicuous seta beneath, the third joint oval, with long, subterminal arista; legs without strong bristles.

the hind tibiæ without the terminal spur; notum densely short-pubescent, the hairs appressed, no humeral or discal bristles; wings broad, costa short-pubescent, third vein sometimes curved forward; halteres usually black.

2. *Endrapetis*, subgen. nov. Type species, *spectabilis* Melander. Robust, larger species, more or less bristly and black; antennæ longer, directed obliquely upward, the second joint with a pronounced seta beneath, the third joint ovate to lanceolate, with a long terminal arista; femora with preapical bristles, anterior tibiæ with apical bristles and the hind ones with a more or less evident terminal spur and usually with extensor or apical bristles; humeral, and sometimes discal bristles (e. g., posthumeral, supraalar and anterior dorsocentrals) present; wings broad, costa short-pubescent, third vein straight or recurved; halteres yellow.

3. *Elaphropeza* Macquart. Type species, *ephippiata* Fallen. Usually yellow, sometimes black species; antennæ elongate, horizontal, the second joint without seta beneath, the third joint lanceolate, two or more times the length of the first two joints together, the terminal arista relatively short, sometimes no longer than the antennæ; abdomen broad, the middle segment with flattened setulæ; legs slender, the hind tibiæ with extensor bristles and with a more or less evident terminal spur; wings narrower, the hairs of the base of the costa longer than elsewhere.

4. *Ctenodrapetis* Bezzi. Type species, *ciliatocosta* Bezzi. Body slender, elongate, usually yellow, the abdomen longer than the thorax; antennæ elongate, horizontal, the second joint without seta, the third joint lanceolate with relatively coarsely pubescent terminal arista; legs slender, with bristles and a long terminal spur on the hind tibiæ; wings long, narrow, cuneate, the costal margin with long cilia.

SYNOPSIS OF THE NORTH AMERICAN SPECIES OF *Drapetis*, S. LAT.

1. Legs mostly black, femora entirely or mostly black........................2.
Anterior femora more or less yellowish, in addition to the knees........23.
2. Hind tibiæ without evident bristles, tibiæ without apical spurs; halteres black; no dorsocentrals..3.
Hind tibiæ almost always with one or more bristles on the extensor side, tibiæ with apical spurs; halteres whitish..............................10.
3. Anterior cross-vein before the middle of the discal cell, last section of the fifth vein much shorter than the preceding; third antennal joint short ovate..4.
Anterior cross-vein beyond the middle of the discal cell, sections of the fifth vein subequal...5.
4. Wings hyaline, third vein uniformly diverging from the fourth; arista terminal..*assimilis* Fallen.
Wings infumated, third and fourth veins parallel toward their end; arista subterminal..*infumata*, n. sp.
5. Third vein uniformly diverging from the straight fourth; pygidium not cleft; head higher than wide, the eyes nearly touching above the antennæ, ocelli minute; mesonotal hairs short..........................6.
Third vein becoming subparallel with the fourth toward the end, the fourth vein with a more or less evident downward bend beyond the discal cell; head globular, the eyes distinctly separated above the antennæ, the ocelli large; mesonotum pubescent..........................7.

6. Hind femora with two strong processes above; fourth vein ending before the tip of the wing, first vein ending before the middle of the wing, third section of the costa shorter than either the second or the fourth; pygidium large..*diversa*, n. sp.

Hind femora unarmed; fourth vein ending beyond the tip of the wing, first vein ending near the middle of the wing, third section of the costa longer than either the second or the fourth; pygidium minute, triangular in outline; front coxæ yellowish....................*naica*, n. sp.

7. Pygidium small, not deeply cleft, circular in outline; last abdominal segment not fringed...8.

Pygdium large, deeply cleft, the left valve with bristly fringe; last segment of male abdomen fringed with hairs..........................9.

8. Hind metatarsi yellowish; notal hairs obliquely outstanding; hypopygium transversely depressed, slightly open on the right side; eastern species ....*pilosa*, n. sp.

Tarsi black; notal hairs decumbent; hypopygium globular and closed; western species...*micropyga*. n.sp.

9. Abdomen and pygidium with fine pale hairs; veins black and thick, the third section of the costa much longer than either the second or the fourth; tarsi and front tibiæ brown................*aliternigra*, n. name

Pygidium with many coarse black setulæ; veins slender, the third section of the costa subequal to the second and the fourth; legs entirely black ....*dividua* Melander

10. Hind tibiæ with long, flattened, scale-like hairs along the inner side and with only preapical bristles, the apical spur large and lappet-like; third antennal joint short ovate, the arista subterminal; third and fourth veins converging apically........................*plumipes*, n. sp.

Hind tibiæ not plumed with long flexor hairs...........................11.

11. Hind tibiæ with six short extensor bristles, the terminal spur strong; arista subdorsal, third antennal joint short ovate.......*dorsiseta*, n. sp.

At most three extensor bristles on the hind tibiæ; arista terminal........12.

12. Hind tibiæ prolonged on the inside as a strong lappet projecting beyond the insertion of the tarsus, hind metatarsi with strong setulæ beneath, middle tibiæ without extensor bristle; four dorsocentrals........... 13.

Hind tibiæ not or scarcely prolonged, certainly not lappet-like, metatarsi setulose only in *medetera*..19.

13. Front coxæ and femora entirely black; anterior cross-vein beyond middle of cell; only middle pair of scutellar bristles long......................14.

Front coxæ somewhat yellowish; anterior cross-vein at or before middle of cell...16.

14. Arista 2.5 times as long as the antenna; hind tibiæ without extensor bristles; upper orbits polished; veins coarse and blackish, the first posterior cell narrowed apically...........................*nitens*, n. sp.

Arista 1.5 times as long as the antenna; hind tibiæ with one or two extensor bristles; occiput pollinose; veins pale, the first posterior cell not markedly narrowed at apex (*unipila* Loew)..................15.

15. Hind tibiæ with one bristle, located at the basal third...var. *unipila* Loew

Hind tibiæ with two extensor bristles, one before the middle, the other at the beginning of the apical third of the tibial length............
var. *nitida* Melander

16. Scutellum with four long equal bristles; hind tibiæ without extensor bristles; hind metatarsi black, darker than the tibia; palpi black....
quadrisetosa, n. sp.

Scutellum with only the middle pair of bristles long; hind metatarsi rarely contrasting..17.

17. Occipital orbits heavily white pruinose; sides of the middle segments of the abdomen white pruinose; posterior cross-vein before the middle of the wing, sections of the fourth vein proportioned 1:1:4, of the fifth vein, 1:1...18.

Orbits not differentiated; sides of the abdomen not pruinose; posterior cross-vein at the middle of the wing, the sections of the fourth vein, 1:1.2:2.3, of the fifth vein, 1:0.5, the second, third and fourth sections of the costa, 1.5:2:1.................................*inculta* Coquillett

18. Hind tibiæ without extensor bristles; second, third and fourth sections of the costa, 2.5:1.6:1, middle segments of the abdomen with flat glistening setulæ; base and apex of the front femora, front tibiæ and base of the front tarsi yellow; palpi yellow......................*lata* Coquillett

Hind tibiæ with a strong extensor bristle near the middle, legs uniformly brownish; costal sections, 1.6:1:8:1; palpi blackish...*spectabilis* Melander

19. Middle tibiæ with a long extensor bristle at the basal third, hind tibiæ with a bristle above and one below the middle, hind femora with a preapical extensor bristle and with three preapical bristles on the front side; five dorsocentrals; pygidium large; hairs of the mesonotum black, of the legs long and blackish................*medetera* Melander

Middle tibiæ without an extensor bristle, hind femora without extensor bristles, hind metatarsi not setulose; pygidium smaller.............20.

20. Hind tibiæ without extensor bristles; antennæ short, the third joint ovate; veins coarse and brown or black.................................21.

Hind tibiæ with two short extensor bristles located at the middle and near the end; antennæ elongate, the third joint lanceolate; veins not coarse and unusually pale...22.

21. Hind femora ♂ with a strong swelling beyond the middle bulging out the anterior side; vertex broadly polished; basal section of the fifth vein slightly longer than the evanescent outer section; legs brown..... *œdimera*, n. sp.

Hind femora not bearing an abnormal swelling; vertex subshining, the occiput cinereous, the front and lower orbits white pruinose; sections of the fifth vein subequal; legs mostly black..........*parvicornis*, n. sp.

22. Front femora ♂ with a bunch of six black setulæ in the middle of the upper side, represented in the ♀ by one or two; no dorsocentrals, dorsum of ♂ nearly glabrous, of ♀ with white hairs; one preapical bristle on the front edge of the hind femora............*armata*, n. sp.

Front femora not setulose, two preapical bristles on the front edge of the hind femora; five dorsocentrals..........................*scissa*, n. sp.

23. Thorax black...24.

Yellow or reddish species; second joint of the antennæ without a seta beneath...41.

24. Under side of hind femora ♂ armed with a pair of long curved black spinous bristles, legs otherwise bristleless; halteres black; third vein curving away from the fourth; pleuræ shining; palpi and base of antennæ yellow......................................*bispina*, n. sp.

Femora not so armed; species differing from preceding also in two or more other characters...25.

25. Third vein curving forward, widely diverging from the fourth; pleuræ opaque pollinose except the center of the sternopleura; halteres and fringe of calypteres yellow..........................*divergens* Loew

Third and fourth veins at least subparallel toward their tip; pleuræ shining except rarely on the sutures.......................................26.

26. Legs without bristles, at most weak hairs on the base of the front femora beneath and near the apex of the hind ones: no dorsocentrals.........27.

Femora and tibiæ with bristles; halteres yellow.........................31.

27. Discal cell long, the ultimate section of the fifth vein much shorter than the preceding, posterior cross-vein opposite the end of the first vein, the anterior cross-vein at or before the middle of the discal cell; mesonotum pubescent...28.

Discal cell small, sections of the fifth vein nearly equal, the posterior cross-vein before the end of the first vein, the anterior cross-vein beyond the middle of the discal cell, the second section of the costa shorter than the third..29.

28. Hind tibiæ ciliate along the outer edge; halteres black; veins dark, the second section of the costa equal to the third.....*latipennis* Melander

Tibiæ not ciliate; halteres yellow; veins brown, the second section of the costa shorter than the third..........................*discalis*, n. sp.

29. Antennæ, palpi and proboscis pale yellow; notum not densely pubescent; veins brown, the third vein straight, ♂ with the pedicel of the second and third veins broadened to a black disk and with a stout flexor bristle near the end of the hind tibia; halteres yellow.....*flavicornis*, n. sp.

Antennæ and mouthparts black; mesonotum densely pubescent; veins black, the third vein sinuous; ♂ not thus distinguished; halteres black.......... 30.

30. Pygidium rounded, closed and without long hairs..........*setulosa*, n. sp.

Pygidium open, asymmetrical, the right side projecting as a curled, black setulose lamella, the left side of the pygidium clothed with long, black, hair-like bristles..........*trichura*, n. sp.

31. Second antennal joint with a long seta beneath; hind femora with preapical bristles on the front side, hind tibiæ with more or less developed apical spur.......... 32.

Second antennal joint without a long seta; hind femora without preapical bristles, hind tibiæ with extensor bristles.......... 39.

32. Hind tibiæ with a strong lappet and with a long extensor bristle at its middle but without subapical bristles; three preapical bristles on the outside of the hind femora, hind metatarsi yellow-setulose beneath; pubescence of the mesonotum long and pale, dorsocentrals present; anterior cross-vein just before the middle of the discal cell; eyes nearly touching above the antennæ..........*spectabilis* Melander

Hind tibiæ without extensor bristle but with subapical ones, hind metatarsi darkened and not setulose; mesonotal pubescence short; eyes distinctly separated above the antennæ.......... 33.

33. Hind tibiæ with a rather strong apical spur.......... 34.

Apex of the hind tibiæ simple; pubescence of dorsum blackish; veins dark..........*gilvipes* Loew

34. Hairs of the thorax and of the calypteres whitish, some weak erect dorsocentrals on the disk of the mesonotum.......... 35.

Hairs of the thorax and calypteres blackish, no erect dorsocentrals on the disk of the thorax; anterior cross-vein beyond the middle of the discal cell.......... 37.

35. Anterior cross-vein at the middle of the discal cell; scutellum with four bristles; veins strong; one strong preapical extensor bristle on the hind tibiæ, femora largely blackish..........*femoralis* Melander

Anterior cross-vein at three-fifths the length of the discal cell, veins weak; scutellum with two bristles; preapical extensor bristle of the hind tibiæ weak, legs mostly luteous.......... 36.

36. Hairs of the thorax fine but dense; face broader above and below and opaque gray pollinose, front pollinose; legs luteous..........*facialis*, n. sp.

Hairs of the thorax sparse; face black, narrower below, the front black; abdomen shining, nearly bare, pygidium very large; hind femora blackish..........*diversipes*, n. sp.

37. Apical spines of the hind tibiæ stout; hind femora usually not blackened; first posterior cell widest before its end..........*xanthopoda* Williston

Spines at the end of the hind tibiæ not unusually stout, hind femora dark on the distal half; third and fourth veins parallel..........
(*septentrionalis* Melander 38.

38. Face linear, eyes subcontiguous beneath the antennæ; palpi black..........
septentrionalis Melander

Face narrow, white pollinose, the eyes distinctly separated; palpi yellow
var. *mexicana*, n. var.

39. Hind tibiæ with a single extensor bristle near the middle; front very narrowly V-shaped; veins blackish and strong..........*inermis*, n. sp.

Hind tibiæ with two extensor bristles; front narrowly V-shaped; veins slender.......... 40.

40. Antennæ black, the third joint lanceolate; hairs of the body black and numerous, six acrostichals; sides of the fifth segment of the abdomen with many short scale-like setulæ; tibial spur short..........*nigricans*, n. sp.

Antennæ yellow, the third joint short; hairs of the body pale and very sparse, two acrostichals; tibial spur long..........*tenera*, n. sp.

41. Hind tibiæ without long extensor bristles, but instead seriately bristly, hind metatarsi with an erect comb of seven bristles; halteres blackish; four rows of acrostichals; first posterior cell widest before the end; tibial spur small..*comata*, n. sp.

Hind tibiæ with two or one long extensor bristles, hind metatarsi not pectinate; halteres yellow..42.

42. Third and fourth veins converging, the first posterior cell widest before its tip; antennæ dark; scutellum and metanotum yellow, four acrostichals; tibial spur small..................................*inflexa*, n. sp.

Third and fourth veins not converging, the first posterior cell widest before its tip; antennæ yellow..43.

43. Mesonotum and pleuræ largely black, the notopleural suture broadly yellow; dorsal hairs long; tibial spur black; one extensor bristle on hind tibiæ; upper orbits polished......................*seminigra*, n. sp.

Thorax mostly or wholly yellow..44.

44. Mesonotum with a median brown vitta, upper pleuræ brown; front linear; tibial spur long..*vitatta*, n. sp.

Mesonotum and pleuræ not vittate; front narrow, its sides converging below..45.

45. Hind tibiæ with a single extensor bristle; posterior half of the mesonotum with a large crescentic black mark......................*upsilon*, n. sp.

Hind tibiæ with two extensor bristles; posterior part of the mesonotum marked at most with a prescutellar spot..............................46.

46. Pleuræ with a large round subalar spot, a rounded prescutellar spot fused with the black scutellum; mesonotal hairs sparse; tibial spur strong but blunt..*pleuralis*, n. sp.

Pleuræ unspotted, mesonotum reddish, sometimes with black metanotum, scutellum and prescutellar spot..47.

47. Tibial spur blunt; third antennal joint conical, twice as long as broad; abdomen yellow apically; sections of the fourth vein proportioned 1 : 3, of the fifth vein, 2.5 : 1......................*rectineura*, n. sp.

Tibial spur long and sharp; third antennal joint less than twice as long as broad; abdomen often entirely black..............................48.

48. Middle tibiæ ♀ not setulose, of ♂ at most microscopically setulose; scutellum reddish, mesonotal hairs sparse; length 1.5–2 mm.........49.

Middle tibiæ ♂ ♀ setulose with black denticles within; scutellum black; genitalia sometimes yellow; mesonotum hairy; sections of the fourth vein, 1 : 2.2; length 2–3 mm..50.

49. Sections of the fourth vein proportioned 1 : 4; abdomen black; occiput polished black, without pollen........................*luteicollis*, n. sp.

Sections of the fourth vein proportioned 1 : 2.2; abdomen black on the middle segments only; occiput subshining, coated with fine gray pollen ....*simplicipes*, n. sp

50. Occiput polished black, without pollen; front femora ♂ ♀ without black setulæ below; third antennal joint yellow, arista slender; pygidium without pollen, shining.......................................*calva*, n. sp.

Occiput pollinose; third antennal joint darker than the basal joints........51.

51. Arista heavily pubescent, appearing half as thick as the third joint; bristles of the hind tibiæ distant; lower part of the head yellow; second section of the costa longer than the fourth and but little shorter than the third..................................*plumea*, n. sp.

Arista not thickly pubescent, less than half as thick as the third antennal joint..52.

52. Front femora ♂ with black setæ beneath, bristles of the hind tibiæ distant ....*flavida* Williston

Front femora ♂ ♀ with black flexor setæ, the bristles of the hind tibiæ close together..(*læta*, n. sp.) 53.

53. Prescutellar dark spot present; wings three times as long as broad; occiput pollinose to the eyes......................*læta*, n. sp. and var.

Prescutellar spot wanting; wings less than three times as long as broad....54.

54. Spur of the hind tibiæ forming a long slender curved yellow hook; occiput pollinose to the eyes..........................var. *ungulifera*, n. var.

Spur of the hind tibiæ forming a large broad black lappet; upper occipital orbits shining ....var. *nigrocalcarata*, n. var.

Drapetis aliternigra, sp. nov.

nigra Melander, Tr. Am., Ent. Soc. xxviii. 208, f. 12, 17, 24 (1902).

Length 1.6 mm. Head round; occiput subshining, bottom of the front one-third to one-half as wide as the second joint; face and cheeks linear; palpi black overlaid with brown; second joint of the antennæ without a seta; one pair of diverging postocellar bristles, two or three verticals. Mesonotum closely pubescent, no discal bristles, the lateral ones confined to three or four in front of the wings, lateral scutellar bristles small; pleuræ shining. Legs simple, without bristles, the front knees more or less brownish.

Washington, British Columbia, Texas, South Dakota, Pennsylvania, New York, Massachusetts.

The species is very close to *naica*, but in that species the third vein has a uniform anterior curve, there are no postocellar bristles, the ocellar and vertical bristles are small and the head is longer than wide, with the front at the bottom less than one-third as wide as the second joint of the antennæ. In *aliternigra* the ocellar, postocellar and vertical bristles vary in size.

Drapetis bispina, sp. nov.

♂. Length 1.4 mm. Head, thorax and abdomen black, legs including the coxæ entirely yellow. Head spherical; occiput lightly dusted, orbits not differentiated; front and face very narrow, almost linear, the lowermost sides of the dusted face somewhat diverging; antennæ one-third the head-height, the basal joints yellowish, the second joint without seta, the third joint black, triangularly ovate, as long as the basal joints together, the terminal arista one-half longer than the antennæ, short-pubescent; palpi and a pair of apical setæ yellow, proboscis brown. Mesonotal hairs blackish, rather long and dense, obliquely outstanding, only the posterior dorsocentral bristles evident, no humeral, 3 supraalar, 1 intraalar, 4 scutellar bristles, pleuræ mostly polished. Abdomen shining, the hairs rather evident especially the brown ones margining the last tergite and the pale ones of the underside of the hypopygium; hypopygium oblong, larger than the vertical diameter of the abdomen, nearly erect but somewhat twisted to the right, its left valve with broad rounded end, the penis exserted as a curled filament. Legs relatively stout, covered with yellow hairs which are long but sparse on the underside of the anterior femora, otherwise devoid of bristles except for a pair of contiguous curved black spines located on the inner flexor side of the hind femora at three-fourths the length and extending as far as the knee, inner apical side of the hind tibiæ with a small luteous lappet covering the very base of the metatarsus, no tibial spurs. Halteres black, the roots fuscous; hairs of the calypteres golden. Wings hyaline, veins narrow and light brown, all the veins diverging, costal sections proportioned 1 : 0.6 : 1 : 0.7, first vein ending at basal two-fifths of the wing, fourth vein terminating conspicuously beyond the tip of the wing, anterior cross-vein located at three-fifths the length of the discal cell, outer sections of the fourth vein proportioned 1 : 6, of the fifth vein, 1 : 0.9, marginal cilia short.

One specimen: Lafayette, Indiana, July 4, 1914. (Melander).

Drapetis diversa, sp. nov.

♂. 1.3 mm. Black, shining, hairs very short and pale, first four longitudinal veins curving forward, the first vein very short, hind femora with two discoid processes above. Head higher than wide, orbits not pollinose, front very narrow, its sides scarcely converging beneath, face linear, black, cheeks very narrow; palpi and proboscis black; antennæ short, the second joint without a seta beneath, the third joint oval, but slightly longer than wide, the bare arista nearly terminal, one and two-thirds times as long as the antennæ. Mesonotum with short close pubescence, the marginal bristles small, two scutellar, about eight rows of fourteen acrostichals; pleuræ not pollinose. Abdomen subshining, laterally subopaque, hypopygium large, the lamellæ with coarse brown hairs. Legs devoid of bristles, the hairs pale, the hind femora greatly swollen above and bearing a strong backward-projecting hook on the proximal fourth of its extensor surface, distal to which near the middle is a prominent disk-shaped protuberance. Halteres yellowish. Wings short, broad, hyaline, veins pale brown, first vein ending before the middle of the wing, the marginal cell broad, the second, third and fourth sections of the costa proportioned 1.2 : 1 : 1, fourth vein.ending slightly before the tip of the wing, the first posterior cell much the widest at its end, anterior cross-vein at two-thirds the length of the second basal cell, outer sections of the fourth vein proportioned 1 : 5, of the fifth vein equal, costa bare, cilia of the hind margin short.

One specimen: Alamogorda, New Mexico.

Drapetis flavicornis, sp. nov.

♀. Length 1 mm. Shining black, the appendages yellow. Head globular, black, subshining, sides of the front slightly diverging above, face linear, shining black, the narrow cheeks, palpi, palpal seta, proboscis, antennæ and arista yellow; antennæ three-jointed, the last joint oval, slightly longer than wide, the arista twice the length of the antennæ and microscopically hairy; ocellar and vertical bristles black. Thorax broader than long, its bristles blackish, its hairs moderately sparse, short and brown; pleuræ polished; abdomen opaque blackish, the middle three segments with two transverse rows of converging setulæ; ovipositor yellowish. Legs without bristles, the hind tibiæ with a broad blunt sericeous terminal lappet. Halteres yellow; calypteres brown. Wings narrow, clear hyaline, veins brownish along the middle of the wing, at the base and apex pale yellowish, the second, third and fourth costal sections proportioned 1 : 1.5 : 0.8, third vein straight, nearly parallel with the fourth, posterior cross-vein somewhat oblique, located before the end of the first vein, sections of the fourth vein proportioned 1 : 0.5 : 3.2, of the fifth vein, 1 : 0.7, marginal cilia as long as the anterior cross-vein.

Type; Le Chorrera, Panama, collected by August Busck, May 12, 1912, for the U. S. National Museum. A male from Jamaica differs only in the following characters which are probably sexual and not specific differences. Pedicel of the second and third veins broadened disc-like and black; hind femora with a strong curved yellow bristle underneath at the outer fourth; mesonotal hairs longer; abdominal setulæ less pronounced.

Drapetis inermis, sp. nov.

♂. Length 1.9 mm. Head black, occiput subshining, front very narrow, its sides converging so as almost to touch, eyes separated below the antennæ by a line, ocellar and vertical bristles moderately long; palpi white and with an apical white hair, proboscis short, reddish; antennæ horizontal, without seta beneath, the third joint lanceolate, nearly twice as long as broad, its terminal arista less than two times the length of the antenna. Thorax shining black, the hypopleuræ alone pollinose, its pubescence white, uniformly distributed, six rows of about eight acrostichals, lateral scutellar bristles small. Base of abdomen not chitinized, the middle segment laterally with a few flattened setulæ; hypopygium shining black, with few hairs. Legs largely brownish, the anterior femora and coxæ and the base of the hind femora yellowish, middle femora alone with a preapical bristle, hind tibiæ with a single extensor bristle located just above the middle, its apex merely callous, metatarsi not setulose. Halteres yellow, calypteres with six cilia. Wings narrow, nearly hyaline, the veins strong and dark, marginal cilia minute, the second, third and fourth sections of the costa proportioned 1.6 : 2.4 : 1, the submarginal cell at the end of the first vein one-half as wide as the marginal, and at the end of the second vein equal in width to the first posterior, third and fourth veins subparallel, the first posterior cell widest beyond the end of the second vein, anterior cross-vein just before the middle of the second basal cell, last two sections of the fourth vein proportioned 1 : 2.5, of the fifth vein, 3 : 1.

One specimen, Alhajuelo, Panama, April 11, 1911, collected by August Busck for the U. S. National Museum.

Drapetis infumata, sp. nov.

♀. Length 1.6 mm. Shining black, mesonotum densely black-setulose, wings infumated. Front broadly V-shaped, at the bottom nearly as wide as the second antennal joint; face narrow, its sides parallel; palpi blackish, with a few dusky hairs; antennæ ascending, the lowermost hair of the second joint setiform, the third joint very short, ovate, the subapical nearly bare arista more than three times as long as the antennæ. No humeral, three or four supraalar, four scutellar, two small prescutellar bristles. Abdomen subshining blackish. Legs blackish, the posterior femora with a small preapical bristle, no tibial bristles, or apical spur. Halteres black. Wings oval, the second, third and fourth sections of the costa proportioned 1.3 : 1.8 : 1, third and fourth veins subparallel, the first posterior cell a little the widest before its tip, anterior cross-vein before the middle of the discal cell, segments of the fourth vein proportioned 1 : 2.3, of the fifth vein, 1.6 : 1, marginal cilia uniformly short.

Type specimen: Nelson, British Columbia, July 17, 1910. Paratype: Priest Lake, Idaho, August 1, 1915 (Melander). In author's collection.

Drapetis micropyga, sp. nov.

♂. Length, 1.5 mm. Black, shining, legs simple without bristles, black, the front coxæ and knees brown, antennæ short, halteres black, third and fourth veins nearly parallel. Head round, orbits shining, bottom of the front one-half as wide as the second joint of the antennæ, face linear, cheeks obliterated, proboscis very short, palpi blackish, brown-hairy and without an apical seta; second antennal joint without seta beneath, the third joint short oval, not longer than wide, the subterminal arista slender, twice as long as the antennæ. Pubescence of the mesonotum short and dense, no discal bristles, the lateral bristles confined to three or four in front of the root of the wings, lateral scutellars small; pleuræ with tomentum in front of the wings and beneath the humeri. Abdomen subshining, nearly bare, hypopygium small, rounded, closed, with uniform short, brown hairs. Wings hyaline, the second, third and fourth sections of the costa proportioned 1 : 1.5 : 1, first posterior cell slightly widening toward the tip, fourth vein ending beyond the apex of the wing, its outer two sections proportioned 1 : 7, sections of the fifth vein equal, anterior cross-vein at two-thirds the length of the second basal cell, marginal cilia uniformly short.

Pullman and Almota, Washington: Moscow Mountain, Idaho. A male from Washington, D. C., does not offer any differences.

Drapetis naica, sp. nov.

1.2 mm. Black, with simple black legs, third vein curving forward, first vein ending near the middle of the wing, hypopygium small. Head higher than wide, orbits not pollinose, front, face and cheeks very narrow, palpi yellowish, the terminal hair pale, proboscis short, black; antennæ short, ascending, the second joint without a seta beneath, the third joint ovate, one-fourth longer than broad, the slender terminal arista one and three-fourths times the antennal length. Thorax with uniform, short, fine, brown hairs, about eight rows of eighteen acrostichal hairs, no humeral, three supraalar, four scutellar, bristles; pleuræ polished; abdomen shining, the sides of the middle segments subopaque and with brown setulæ; hypopygium small, rather triangular in profile, its valves not open. Front coxæ and knees brownish, posterior femora with a single preapical bristle, spur of the hind tibiæ long but blunt, metatarsi not setulose. Halteres blackish. Wings hyaline, veins brown and thin, the first four veins curving forward, first vein ending near the middle of the wing, the second, third and fourth sections of the costa proportioned 1 : 1.2 : 1, fourth vein ending beyond the tip of the wing, its outer two sections proportioned 1 : 6, anterior cross-vein at two-thirds the length of the second basal cell, costa and hind margin uniformly short-ciliate.

Various places in Washington, Idaho, New Mexico and Texas.

Drapetis pilosa, sp. nov.

Length 1.25 mm. Black species with halteres and the major portion of the legs black. Head almost spherical, front V-shaped, dusted, ocelli large, face linear; mouthparts black, no long palpal hairs; occiput lightly dusted, orbits not differentiated, cheeks linear; antennæ one-third the head-height, ascending, the second joint not setigerous, the third joint triangularly ovate, scarcely longer than deep, the arista subterminal, three-fourths longer than the antenna. Mesonotum shining, the hairs relatively long, conspicuous and obliquely erect, no humeral, one dorsocentral, one intraalar bristle, only the apical pair of scutellar bristles long; pleuræ polished. Abdomen shining, disc bare, lateral hairs short, stiff and black, last segment without long fringe, fourth segment much longer than any of the others; hypopygium small, transversely depressed, the parts on the right side slightly exposed. Legs entirely bristleless, no tibial lappet or spurs, front tibiæ and all the tarsi yellowish-brown. Hairs of calypteres black. Wings hyaline, veins very thin, brownish, the first vein ending at the middle of the wing, sections of the costa proportioned 1 : 0.4 : 0.7 : 0.3, of fourth vein, 0.3 : 0.2 : 10, third vein sinuate and apically parallel with the fourth, sections of fifth vein subequal.

♀, thoracic pubescence slightly shorter than in ♂.

Type: Lafayette, Indiana, July 4, 1914 (Melander). Four paratypes, Chicago, Illinois, June 28, 1914, on shrubbery in vacant lots near the lake shore (Melander).

Drapetis setulosa, sp. nov.

Length 1.3 mm. Shining black, hairs of the mesonotum numerous and black, legs yellowish. Occipital and ocellar bristles stout, lower part of the front one-third as wide as the second antennal joint; palpi blackish, but covered with white hairs; eyes together higher than broad, obliterating the cheeks; antennæ short, ascending, no seta beneath, the third joint short-ovate, with nearly bare subterminal arista measuring three times the antennal length. Mesonotum shining, densely short-hairy; no humeral, five supraalar bunched together, two small prescutellar, two scutellar bristles. Abdomen sub-shining black, hypopygium small, rounded, apically with numerous short yellowish hairs. Legs short, yellowish to brown, the front ones lighter, the hind ones darker, no bristles or terminal spur. Halteres blackish. Wings hyaline, third vein lightly sinuose, parallel with the fourth toward its end, the fourth vein with a downward curve in the middle of the wing, then straight, the second, third and fourth sections of the costa proportioned 1.2 : 1.8 : 1, submarginal cell as wide as the marginal and the first posterior opposite the ends of the first and second veins respectively, anterior cross-vein near the middle of the second basal cell, outer sections of the fourth vein proportioned 1 : 6, of the fifth vein equal, marginal cilia uniformly short.

Two specimens: Pullman and Almota, Washington, June. A specimen in the U. S. National Museum from South Fork, British Columbia, has the third vein a little closer to the fourth.

Drapetis trichura, sp. nov.

♂. Length 1.4 mm. Black, legs yellowish, hairs black and abundant, the last tergite, apex of hypopygium and of the apical lamella with numerous bristly hairs. Front V-shaped, eyes nearly meeting just above the antennæ and on the middle of the face; cheeks narrow; vertical and ocellar bristles short, upper occiput setulose; antennæ ascending, short, black, no seta beneath, the third joint not longer than broad, ovate, with a subterminal arista nearly bare and measuring two and one-half times the antennal length; palpi white and with straggling white hairs, proboscis very short. Mesonotum shining, densely hairy, about ten rows of setulæ between the dorsocentral rows; no humeral, three notopleural, two dorsocentral, four scutellar bristles; abdomen opaque blackish, hypopygium polished jet black. Legs short, simple, without true bristles on the femora or tibiæ, no apical spur on the hind tibiæ. Halteres blackish. Wings hyaline, the third vein with a strong anterior curve, fourth vein nearly straight but with a slight posterior curve at the middle of the wing, the submarginal cell opposite the end of the first vein two-thirds as wide as the marginal, and at the end of the second vein two-thirds as wide as the first posterior cell, anterior cross-vein at two-thirds the length of the second basal cell, the outer two sections of the fourth vein proportioned 1 : 10, of the fifth vein equal, costa and hind margin uniformly short-ciliate.

One specimen: Austin, Texas.

Eudrapetis armata, sp. nov.

Length 1.8 mm. Black, shining, with black legs, the femora with a single preapical bristle, front femora ♂ above along the middle with a group of about six spines, reduced in the ♀ to one or two, hind tibiæ with two short extensor bristles located at the middle and about half way to the tip, the apical spur small. Front subshining, at the bottom two-thirds as wide as the second antennal joint, face half as broad as this joint, its sides diverging below, subshining black, cheeks broader behind where they are about one-fifth the eye-height; palpi black but the front surface white pruinose, the apical hair black, proboscis black; antennæ elongate, ascending, the second joint with a seta beneath, the third joint lanceolate, about twice as long as broad, its terminal arista rather heavy with close short pubescence, measuring one and two thirds times the antennal length. Thorax ♂ nearly bare, narrowly tomentose before the scutellum and around the root of the wing and conspicuously so below the humeri; pleuræ shining; one strong humeral, four supraalar, one intraalar almost posthumeral in position, two prescutellar, four scutellar, the lateral ones short; in the ♀ the notal hairs are long, fine, abundant and whitish, the lateral bristles are shorter and the subhumeral region is provided with white hairs instead of tomentum. Abdomen shining, nearly bare, in the ♂ the hairs are blackish and stronger, along the sides of the middle segment slightly flattened, hypopygium short, rather small, its appendages open above. Legs sometimes more or less reddish near the end of the hind tibiæ, the hind metatarsi not setulose, apical spines of the anterior tibiæ long. Halteres white, calypteres with about eight dusky cilia. Wings yellowish hyaline, veins pale brown, first posterior cell rather broad, its veins parallel outwardly, the second, third and fourth sections of the costa proportioned 1.3 : 1.3 : 1, anterior cross-vein at three-fourths the length of the second basal cell, outer two sections of the fourth vein proportioned 1 : 7, of the fifth vein equal, marginal cilia uniformly short.

Numerous specimens from Washington, Idaho, Massachusetts and Maine. One specimen from Olga, Washington, has three extensor bristles on the hind tibiæ.

Eudrapetis discalis, sp. nov.

♂. Length 1.4 mm. Shining black, closely pubescent, legs yellow, posterior cross-vein at the middle of the wing. Occiput with short, brownish hairs and bristles; front V-shaped, at the bottom one-half as wide as the second antennal joint, face and cheeks linear; palpi blackish with a few brown hairs, proboscis short, black; antennæ ascending, the second joint with a seta, the third joint short-ovate, the subterminal arista slender, bare, over three times the antennal length. Hairs of the thorax short, dense, pale, no humeral, three supraalar, four scutellar bristles. Sides of the abdomen subopaque, with white pubescence, disk shining, hypopygium elongate, outwardly with white hairs. Legs slender, the hind femora with short preapical bristles, no tibial bristles or spur. Halteres blackish. Wings hyaline, veins narrow, brownish, third and fourth veins subparallel, the third lightly sinuose, so that the first posterior cell is widest before its apex, second, third and fourth sections of the costa proportioned 1.4 : 1.8 : 1, anterior cross-vein at two-fifths the length of the second basal cell, the outer two sections of the fourth vein proportioned 1 : 1.8, of the fifth vein, 2 : 1, marginal cilia uniformly very short.

Two specimens: Wawawai, Washington, and Palo Alto, California.

Eudrapetis diversipes, sp. nov.

♂. Length 1.9 mm. Black, shining, legs yellowish, the hind femora and metatarsi blackish, hairs of the thorax rather sparse, fine and pale, hypopygium very large. Vertex, front and face grayish black, vertical and ocellar bristles large, front beneath nearly as wide as the second antennal joint, face very narrow, linear beneath, occipital orbits grayish, cheeks broader behind where they are one-tenth the eye-height; palpi brownish, with apical black hair, proboscis brown; antennæ black, the second joint with a long seta beneath, third joint broken. Four rows of about nine acrostichals, no discal bristles, two scutellars; pleuræ not pollinose. Abdomen shining, nearly bare, hypopygium with very sparse whitish hairs, the right lamella large, broad and deeply cleft. Legs luteous, the hind coxæ, femora and metatarsi blackish, pubescence whitish, anterior femora with a single preapical, the hind femora with two preapical bristles, anterior tibiæ with a pair of apical spines, those of the hind tibiæ small, its apical spur rather strong and pointed, no extensor bristles on the tibiæ, hind metatarsi not setulose. Halteres whitish. Wings hyaline, veins pale brown, the fourth vein very slightly undulate, apically parallel with the third vein, the second, third and fourth sections of the costa proportioned 1.6 : 1.6 : 1, anterior cross-vein at two-thirds the length of the second basal cell, outer sections of the fourth vein proportioned 1 : 6, of the fifth vein equal, marginal cilia uniformly very short.

One specimen: Santa Cruz Mountains, California, received from Professor R. W. Doane.

Eudrapetis dorsiseta, sp. nov.

♀. Length 2 mm. Shining black, the spur of the hind tibiæ and the matted pubescence of the hind metatarsi brown. Second antennal joint with a long seta beneath, third joint ovate, scarcely longer than broad, the arista arising before the end of the third joint, slender, loosely microscopically hairy, measuring three times the antennal length; face linear, white-pollinose, clypeus shining, cheeks narrow in front, broad behind, lower orbits white-pollinose. Dorsum of the thorax loosely hairy, five hairs in the dorsocentral rows a little longer; halteres yellow. All the femora with a single preapical bristle, front tibiæ with one strong preapical flexor bristle, hind tibiæ with five erect extensor bristles which in length are equal to the diameter of the tibiæ but the apical one longer, on the outer side with two short, strong, apical spines and on the inner side with a strongly projecting, broad, blunted spur, hind metatarsi somewhat swollen, not bristly except for one apical setula. Wings narrow, long, hyaline, the veins coarse and black, first vein ending at the middle of the wing, the second, third and fourth sections of the costa proportioned 3.5 : 3.7 : 1, third and fourth veins mutually converging at the tip, anterior cross-vein at three-fifths the length of the second basal cell, the outer two sections of the fourth vein proportioned 1 : 7, of the fifth vein 4 : 3, margin with short cilia.

One specimen: Juan Vinas, Costa Rica, collected by Dr. P. P. Calvert for the Philadelphia Academy of Science.

Eudrapetis facialis, sp. nov.

Length 1.5 mm. Broad, black, shining, mesonotum with dense, white hairs and with erect dorsocentrals on the disk, face white-pruinose, legs yellowish. Posterior orbits white-pruinose, front opaque black, as broad as the second antennal joint, face relatively broad, narrowest in the middle, cheeks obliquely descending in back, one-ninth the eye-height; palpi yellow, proboscis blackish; antennæ black, ascending, the second joint with a seta beneath, the third joint lanceolate, one-half longer than wide, the arista terminal, slender, twice as long as the antennæ. Pleuræ pollinose posteriorly and more or less along the sutures; abdomen shining except along the extreme sides, its hairs sparse, white, hypopygium small, globular. Legs luteous, the hind metatarsi dark, anterior femora with one preapical, hind femora with two, hind tibiæ without extensor bristles but with one pair each of short, stout preapical and apical bristles. Halteres pale yellow; calypteres fringed with six fine white cilia. Wings hyaline, veins pale brown, third and fourth veins converging, the second, third and fourth sections of the costa proportioned 2 : 2 : 1, anterior cross-vein at two-thirds the length of the second basal cell, the outer two sections of the fourth vein proportioned 1 : 4, the outer section of the fifth vein shorter than the preceding, margin uniformly short-ciliate.

Two specimens: Okefenokee Swamp, Georgia, June, received through Professor O. A. Johannsen of Cornell University; and Medicine Hat, Alberta, collected by J. R. Malloch and deposited in the U. S. National Museum.

Eudrapetis nitens, sp. nov.

♀. Length 1.4 mm. Head and body entirely jet black, the legs dark brown, the halteres white. Face linear, front narrowly V-shaped, at the bottom nearly as broad as the width of an antennal joint; lower third of orbits pollinose, occiput, vertex, front and oral margin polished; palpi and proboscis black, the former cinereous pubescent; second antennal joint bisetose below, third joint short oval, the arista slender, microscopically sparsely pubescent, and two and a half times as long as the antenna. Thorax entirely polished, the notal hairs moderate in length and density, the central and distant two scutellar bristles alone long. Hairs of hind tibiæ rather long, four pronounced preapical but no extensor bristles present, the apical lappet strong. Wings lightly infumated, veins strong and blackish, costal sections approximately 1 : 0.6 : 0.8 : 0.3, third and fourth veins converging at apex, sections of fourth vein as 0.5 : 0.4 : 1.8, of fifth vein, 4 : 5.

Type: Panama, March, 1915, received from Dr. A. H. Sturtevant. Paratypes from Havana, Cuba (Sturtevant, and Orizaba, Mexico, (Wm. M. Mann, in Museum of Comparative Zoology) differ in having the legs usually quite black, the posterior occiput slightly pollinose and the mesonotal hairs sparse. A male from Aquada, Panama (Sturtevant), has brown legs and wing-veins. The hypopygium is globose but not larger than the abdomen.

Eudrapetis nuda, sp. nov.

Length 1.6 mm. Shining black, pubescence pale, short and very fine, legs devoid of bristles, yellow, the hind femora largely black. Occipital orbits white-pollinose; eyes separated above the antennæ nearly as much as the width of the second antennal joint, front subshining black; face gray, linear in the middle, cheeks one-tenth the eye-height, their lower edge horizontal; palpi white and with a terminal white hair, proboscis brown; basal joints of the antennæ yellow, the second joint with a seta beneath, the third joint lanceolate, fuscous, two-thirds longer than broad, with short pubescence, the terminal arista nearly bare, two times the antennal length. Thorax closely covered with short and very fine white hairs, no evident dorso-centrals on the disc, four scutellars, pleuræ with gray tomentum following the notopleural and the meso-sternopleural sutures. Abdomen subopaque black, its short sparse hairs black, hypopygium of moderate size, shining, with white hairs beneath, the left side with a trifurcate process. Legs simple, without spines or bristles, hind tibiæ not spurred, the last tarsal joint a little darker. Halteres yellowish. Wings hyaline, veins thin, brownish, the third and fourth veins rather strongly convergent, the fourth vein curving forward toward its tip, second vein shorter than usual, the second, third and fourth sections of the costa proportioned 1.3 : 4.5 : 1, outer sections of the fourth vein proportioned 1 : 6, of the fifth vein subequal, marginal cilia uniformly short.

Numerous specimens: Kamerun, West Africa, received from Professor Roland Thaxter.

Eudrapetis œdimera, sp. nov.

♂. Length 1 mm. Shining black, with brown legs, black antennæ, blackish palpi, dirty white halteres and strong dark brown veins; hind femora with a pronounced swelling beyond the middle of the anterior face. Second antennal joint with a long inferior seta, third joint short, oval, scarcely longer than wide, its arista long and slender, measuring four times the antennal length, microscopically hairy. Vertex broadly polished, ocellar triangle prominent, occiput slightly dusted, the lower orbits and the lower front only inconspicuously cinereous, face linear, black. Hairs of mesonotum very sparse, brownish, those of the dorsocentral rows long, scutellum somewhat dusted; pleuræ entirely polished; abdomen nearly bare, largely shining, pygidium small, elliptical in outline, sparsely hairy. Anterior tibiæ with fine apical bristles, hind femora with two apical bristles on the anterior side, hind tibiæ without extensor bristles but with a group of three at the tip, metatarsi not setulose. Wings hyaline, veins broad, the fifth vein evanescent midway between the posterior cross-vein and the margin, first four veins with a slight anterior curvature, the third and fourth veins nearly parallel, second, third and fourth sections of the costa proportioned 1 : 1.4 : 0.6, anterior cross-vein at three-fourths the length of the discal cell, the posterior cross-vein a little before the end of the first vein, fourth vein ending at the wing-tip, its sections proportioned 3 : 1 : 9, basal section of the fifth vein slightly longer than the outer, marginal cilia much longer than the anterior cross-vein, nearly as long as the posterior cross-vein.

One specimen, in the U. S. National Museum. Cordoba, Vera Cruz, Mexico, May 13, 1908, collected by Dr. A. Fenyes.

Eudrapetis parvicornis, sp. nov.

♂, ♀. Length 1.2 mm. Black, shining, the hairs fine, sparse and yellowish. Occiput and front opaque black, eyes separated on the face by a narrow line of pollen, antennal incision deep, front at bottom as broad as the base of an antenna; ocellar and vertical bristles strong; palpi black but white pruinose; antennæ short, black, the second joint with a long seta beneath, the third joint rounded oval, no longer than the second joint, its terminal arista nearly bare. No humeral, two small prescutellar dorsocentral, two scutellar bristles; pleuræ polished. Pygidium large, ovate, closed, its hairs short, sparse and pale. Legs black, the under side of the anterior femora reddish brown, hind femora with two preapical bristles, hind tibiæ with three apical bristles and with a strong spur, but without extensor bristles. Halteres fuscous, calypteres margined with six cilia. Wings short and broad, lightly infumated, the veins coarse and dark, margin uniformly short-ciliate, second, third and fourth sections of the costa proportioned 1.7 : 1.8 : 1, third and fourth veins outwardly subparallel, anterior cross-vein at the outer third of the second basal cell, the last two sections of the fourth vein proportioned 1 : 9, of the fifth vein equal.

Three specimens: Pullman, Washington, March 5, (Melander), and Rock Creek, D. C., March 9 (R. C. Shannon). Paratype in U. S. National Museum.

Eudrapetis pennescens, sp. nov.

♀. Length 2.25 mm. Differing from *armipes* Bezzi in the following respects: Legs blacker, the hind femora with only one pronounced knee bristle, the hind tibiæ with five or six long contiguous hair-like bristles forming a feather-like row along the middle of the inner side and with a strong terminal lappet and stout subapical bristles, the hind metatarsi with blackish and not golden pubescence; wings clear hyaline. Differing from ***plumipes*** in being larger and more robust and in having the mesonotum closely white-pubescent, the hind femora with a single knee bristle and the wings hyaline.

Shining black, pubescence white, bristles black, the narrow front, linear face and lower orbits cinereous pruinose; legs almost black, the hind tibiæ dark brown; halteres white; veins black and strong. Palpi blackish, oral margin polished, seta of the second antennal joint strong.

Second and third sections of the costa subequal, third and fourth veins converging, outer part of the fifth vein abruptly weak, sections of the fourth vein proportioned 3 : 2 : 9, of the fifth vein equal.

One specimen: Matucana, Peru, collected by C. T. Brues, July 1, 1913.

Eudrapetis plumipes, sp. nov.

♀. Length 1.2 mm. Black, legs blackish, the hind tibiæ with long, feathery, flexor hairs and with a strong terminal lappet, halteres yellow, third and fourth veins convergent. Sides of the pollinose front nearly parallel, face linear, whitish, upper occipital orbits polished, lower orbits pruinose, ocellar bristles large and black; palpi brown, without setæ, proboscis black; second antennal joint with a long seta beneath, third joint oval with the arista subterminal, microscopically and closely hairy and more than three times the length of the antennæ. Thorax glistening black, only a narrow pruinose line extending from the middle coxæ to the halteres, pubescence long and very sparse, about five short dorsocentrals visible; hairs of the abdomen rather long. Anterior tibiæ with two terminal bristles, hind femora with two strong preapical bristles, hind tibiæ with three preapical bristles on the exterior side opposite the sharp lappet, hind metatarsi black. Wings somewhat infumated, veins coarse, blackish, basal bristle long, the second, third and fourth sections of the costa proportioned 1 : 1.2 : 0.4, first posterior cell distinctly widest at its outer third, sections of the fourth vein proportioned 1 : 0.3 : 3.2, of the fifth vein, 1 : 0.9.

Type specimen: Austin, Texas. Paratype, Kushla, Alabama, received from Dr. A. H. Sturtevant. Paratype, Orizaba, Mexico, collected by Wm. M. Mann and deposited in the Museum of Comparative Zoloogy of Harvard University.

Eudrapetis quadrisetosa, sp. nov.

♂. Length 2 mm. Jet black, the halteres whitish. Face linear, pollinose; front V-shaped, nearly shining, at the lowest part nearly as broad as an antennal joint; upper orbits and vertex polished, lowest third of the orbits white pruinose, oral margin broadly shining black; proboscis and palpal ground-color black; second antennal joint with one long bristle beneath, third joint short ovate, the slender subterminal arista nearly three times the antennal length. Notal hairs long, fine, brown and rather abundant, scutellum with an extra pair of long, apical bristles making four long equidistant scutellars in addition to the minor lateral pair. Abdomen with sparse golden hairs; pygidium globose, not swelling the abdomen. Legs sturdy, nearly black, hind tibiæ more brown, hind metatarsi darker than the adjacent joints, front tibiæ with two apical spurs, hind tibiæ without extensor bristles but with two short but stout preapical spurs, the terminal lappet strong, hind metatarsi scarcely visibly setulose. Wings subhyaline, veins dark but narrow, costal sections proportioned 1 : 0.6 : 0.8 : 0.2, third and fourth veins slightly convergent, sections of the fourth vein, 0.6 : 0.5 : 2.1, of fifth vein equal.

Type: San Jose, Costa Rica, Central America, March, 1915, received from Dr. A. H. Sturtevant. Paratypes from same locality and from Orizaba, Mexico (Mann and Skewes), the last in the Museum of Comparative Zoology, Harvard University.

Drapetis scissa, sp. nov.

Drapetis medetera Melander, in part, Tr. Am. Ent. Soc. xxviii, 208 (1902).

Length 1.7 mm. Shining black, thorax with black hairs and discal dorsocentrals; extensor bristles, apical spines and spur of hind tibiæ small; antennæ elongate; halteres white; third and fourth veins slightly converging toward tip. Head round, occipital orbits grayish black, bottom of the shining black front two-thirds as wide as the second antennal joint, face black narrowed in the middle where it is nearly one-half as wide as the second antennal joint, cheeks scarcely deepened behind, one-tenth the eye-height; palpi black, but overlaid with gray, proboscis black; antennæ ascending, second joint with a seta beneath, third joint lanceolate, three-fourths longer than broad, the terminal arista one and three-fourths the antennal length. Pubescence of the thorax fine and rather sparse, six rows of about ten acrostichals, five or six long, slender dorsocentrals, one humeral, one intraalar, two notopleural, three supraalar, four scutellar bristles; a little pollen before the scutellum, pleuræ shining. Abdomen shining, its hairs pale and long, hypopygium of moderate size. Legs black, the pubescence pale, anterior femora with one, hind femora with two preapical bristles, extensor bristles of hind tibiæ located beyond the middle and near the apex, metatarsi not setulose. Halteres white, calypteres with eight pale cilia. Wings broad, hyaline, veins pale brown, the second, third and fourth sections of the costa proportioned 1.4 : 2 : 1, anterior cross-vein at three-fourths the length of the second basal cell, outer two sections of the fourth vein proportioned 1 : 5, of the fifth vein equal, first posterior cell widest before its end, marginal cilia uniformly small.

Clayton, Washington; Oxford, Idaho; Hunter's Creek and Rock River, Wyoming, the last from the collection of the University of Kansas.

Eudrapetis septentrionalis, var. **mexicana,** var. nov.

♂. A shining black species with yellowish legs, the hind femora blackened apically, especially along the posterior side, hind metatarsi blackish, palpi yellow. Head higher than long, the lower front, the narrow face and the lower orbits silvery pruinose. Pubescence of the body yellowish, about four longer hairs in the dorsocentral rows. Veins pale brown, posterior cross-vein before the end of the first vein, second to the fourth sections of the costa proportioned 1 : 1.2 : 0.6, sections of the fourth vein, 1 : 0.4 : 3.3, of the fifth vein, subequal, marginal cilia a little longer than the anterior cross-vein.

One specimen, in the U. S. National Museum. Collected by F. C. Bishopp, at Tampico, Mexico, December 6.

Eudrapetis spinipes, sp. nov.

Length 1.6 mm. Body polished black, very sparsely hairy, legs luteous, hind tibiæ with several black spinous bristles toward its apex. Front broadly V-shaped, gray pollinose, at the bottom nearly as wide as the second antennal joint, eyes subcontiguous at the middle of the face, lower occiput white-pruinose, cheeks broad, their greatest diameter one-fifth the eye-height; palpi broad, yellowish, with a single apical hair, proboscis nearly as long as the eye-height, brown; antennæ black, the second joint with a long seta beneath, the third joint oval, slightly longer than broad, the slender subterminal arista loosely microscopically pubescent. The very sparse and short hairs of the thorax black, no dorsocentrals, two scutellars; pleuræ entirely polished. Abdomen shining black, its sparse hairs brown; hypopygium small, closed, beneath with white hairs. Legs including the coxæ and ends of the tarsi entirely yellow, anterior femora with a single preapical, hind femora with two preapical bristles, anterior tibiæ tipped with a pair of long, black spines, hind tibiæ at two-thirds their length with a long flexor spine, beyond which on the outside are two preapical and two apical spines, all long, on the inside the short broad apical spur is strong, metatarsi not setulose beneath. Halteres yellow. Wings brownish, veins narrow but firm, the third and fourth veins subparallel, the first posterior cell widest before its apex, the second, third and fourth sections of the costa proportioned 1.6 : 2.4 : 1, anterior cross-vein at two-thirds the length of the second basal cell, outer sections of the fourth vein proportioned 1 : 9, of the fifth vein subequal, marginal cilia uniformly short.

Numerous specimens: Kamerun, West Africa, received from Professor Roland Thaxter.

Ctenodrapetis aristalis, sp. nov.

♂, ♀. Length 1.4 mm. Head glistening black, thorax reddish, abdomen largely or completely black, legs yellow. Front very narrow, eyes contiguous below the antennæ, vertical and ocellar bristles long; basal joints of the antennæ short, yellow, without bristles beneath, the third joint elongate, bluntly oval, thickly black-pubescent, the terminal arista twice as long as the antennæ, with dense black pubescence, so as to appear nearly as thick as the antenna itself. Palpi white; proboscis yellow. Thorax polished reddish yellow, the scutellum and metanotum brown, not pubescent, five pale dorsocentrals, the hindmost long, two scutellars. Abdomen with scattered pale hairs, those of the last segment long, apex of the four basal segments sometimes whitish; hypopygium longer than broad, with few hairs and with asymmetrical appendages visible. Legs slender, including the coxæ pale yellow, the anterior tibiæ and tarsi a little darker, hind tibiæ with only a slight apical swelling and with a single extensor bristle located at the middle, anterior femora with a fine basal hair beneath and all the femora with a preapical bristle on the front side. Halteres white; calypteres white and with four long, pale hairs. Wings clear hyaline, veins yellowish, the outer half of the fourth and fifth veins darkest, costa provided with long, isolated hairs only on the basal half; in outline the wings are narrow, especially on the proximal portion, the anal angle almost entirely reduced; third section of the costa slightly longer than the second, and two and one-half times as long as the fourth section, third vein lightly sinuose, diverging from the fourth and with an anterior curve at its very apex, the submarginal cell beyond the second vein as wide as the first posterior, the anterior cross-vein short, located at three-fifths the length of the second basal cell, last two sections of the fourth vein proportioned 1 : 5, of the fifth vein, 5 : 3; marginal hairs long.

Thirty-five specimens: Manila, Philippine Islands, Robert Brown, collector, from the U. S. National Museum.

Ctenodrapetis cuneipennis, sp. nov.

♀. Length 1.5 mm. Head globular, occiput glistening black, nearly bare, the vertical and ocellar bristles rather short, front narrow, its sides parallel, eyes contiguous below the antennæ; antennæ yellowish, without bristles beneath, the third joint slightly darker, bluntly lanceolate and densely short-pubescent, two and one-half times as long as wide, the terminal arista one and one-half times the antennal length, bushy with dense black pubescence so as to appear nearly as thick as the antenna itself. Palpi white; proboscis yellow. Thorax flavous, including the scutellum, metanotum and pleuræ, but with a brown spot above the root of each wing. The four basal segments of the abdomen whitish with very narrow, brown sclerites, the tergite of the fifth segment large, corneous and brown. Halteres white; calypteres with two pale hairs. Legs slender, pale yellow, the hind tibiæ with small apical spur and with two extensor bristles near the middle. Wings slender, hyaline, the veins pale, the anal angle very greatly reduced, the third section of the costa twice as long as either the second or the fourth, the third vein lightly sinuous and diverging from the fourth so that the submarginal cell is not nearly so broad as the first posterior, anterior cross-vein short, located before the middle of the second basal cell, the last two sections of the fourth vein proportioned about 1 : 3, of the fifth vein, 5 : 3, marginal hairs long.

One specimen: Manila, Philippine Islands, Robert Brown, collector; in the U. S. National Museum.

Elaphropeza calva, sp. nov.

1.5 mm. long. Shining yellow species with yellow legs, the occiput polished black, the middle segment of the abdomen blackish; middle tibiæ denticulate within, spur of the hind tibiæ short, posterior cross-vein at the middle of the wing. Antennæ entirely yellow, the third joint ovate, one-half longer than broad, the arista microscopically pubescent and three times as long as the antennæ; front narrow, shining, face linear; occiput with a little pollen near the neck, the yellow hairs and bristles prominent; mouthparts yellow. Hairs of the thorax long but sparse, scutellum and metanotum reddish brown; base and apex of the abdomen testaceous yellow, the pygidial valves rather large, lateral hairs of the middle segment scale-like. Legs hairy and moderately stout, the middle femora a little the strongest, front femora not setose, the distance between the bristles of the hind tibiæ less than one-third the length of the tibiæ, the terminal spur small and yellow. Wings narrow, more than three times as long as broad, veins yellow, second, third and fourth sections of the costa proportioned 1 : 1.8 : 0.8, sections of the fourth vein, 1 : 1 : 2.3, of the fifth vein, 1 : 0.4.

Six specimens: Corazal, Panama, and Motzorongo, Vera Cruz. Type in the U. S. National Museum.

Elaphropeza comata, sp. nov.

♂. Length 1.75 mm. Head black, thorax entirely reddish, middle segments of the abdomen blackish, hairs and bristles pale, hind legs loosely pectinate. Front very narrow, almost linear; antennæ fuscous, without seta beneath, the third joint lanceolate, two times as long as broad, the arista twice as long as the antennæ, with short pubescence; palpi and proboscis yellow. Thorax rather hairy, four rows of about seven acrostichals, two scutellar bristles. Middle segment of the abdomen with many flattened setulæ, last tergite with long hairs, hypopygium elongate, with numerous hairs at apex and below. Legs yellow, the last tarsal joint dark, middle femora alone with preapical bristle, hind tibiæ without long extensor bristles, but instead with a series of about ten shorter, regularly placed, erect bristles, similarly the hind metatarsi provided with seven erect extensor bristles, spur of hind tibiæ very small and blunt. Halteres dusky, calypteres with eight dusky cilia. Wings rather broad, clear hyaline, the veins brown, the second, third and fourth sections of the costa proportioned 1.6 : 2.5 : 1, the third and fourth veins nearly straight, very slightly converging apically so that the widest part of the first posterior cell is just beyond the termination of the second vein, anterior cross-vein before the middle of the second basal cell, last two sections of the fourth vein proportioned 1 : 2, of the fifth vein, 3 : 1.

One specimen: Trinidad Island, West Indies, collected by August Busck, for the U. S. National Museum.

Elaphropeza inflexa, sp. nov.

Length 1.4 mm. Occiput black, front narrowly V-shaped, at the bottom one-third as wide as the second antennal joint; antennæ rather short, blackish, the second joint without seta, the third joint broadly lanceolate, one-half longer than broad, the arista short-pubescent and one and three-fourths times as long as the antennæ; palpi short, whitish, proboscis red. Thorax, including the scutellum and metanotum luteous, unmarked, the hairs noticeable but scattered, four rows of about six acrostichals. Abdomen blackish, the sides of the middle segment with many minute scale-like setulæ, last tergite fringed but the elongate hypopygium nearly bare. Legs yellow, the front femora with a short preapical bristle, that of the middle femora stronger, hind tibiæ with two extensor bristles trisecting its length and with a short blunt terminal spur. Halteres dirty yellow, calypteres fringed with five cilia. Wings clear hyaline, the second, third and fourth sections of the costa proportioned 1.5 : 2.5 : 1, third vein with pronounced anterior curve, the fourth vein nearly straight, submarginal cell at the end of the first vein nearly as wide as the marginal cell, and beyond the end of the second vein narrower than the first posterior cell, which latter is widest at three-fourths its length, the last two sections of the fourth vein proportioned 1 : 2.7, of the fifth vein, 2 : 1, marginal cilia short.

Four specimens, Canal Zone, Panama, collected by August Busck for the U. S. National Museum. The species is near *formosæ* Bezzi, but has a longer arista.

Elaphropeza læta, sp. nov.

♂, ♀. Length 1.7 mm. Shining yellow, with yellow antennæ, mouthparts and legs, the scutellum, metanotum, abdomen and a prescutellar spot blackish; middle tibiæ denticulate within, front femora not black setose. Head black except the posterior oral margin, occiput cinereous-pollinose, front very narrow, almost linear, shining, eyes of male contiguous below the antennæ, obliterating the face, in the female the eyes are subcontiguous; vertical bristles brown, palpal setæ yellow; third antennal joint ovate, one-half longer than broad, the arista closely but microscopically pubescent, brown, two and a half times as long as the antennæ. Hairs of the thorax moderately abundant and long, bristles yellow. Middle segment of the abdomen darkest, with lateral flattened setulæ, pygidium sericeous. Legs rather slender, front femora sparsely ciliate below, middle femora with strong preapical bristle, not denticulate below, the antero-flexor edge of the hind femora with stiff yellow setæ, six outstanding extensor hairs toward the base of the hind femora, hind tibiæ with a rather strong black terminal lappet, the two extensor bristles separated by less than one-third the length of the tibia. Wings three times as long as broad, veins strong and brown, second, third and fourth sections of the costa proportioned 1 : 1.3 : 0.8, third and fourth veins straight, slightly diverging, sections of the fourth vein proportioned 0.9 : 1 : 2.2, of the fifth vein, 1 : 0.4.

Five specimens: Alhajuelo, Panama; August Busck, collector. Type in U. S. National Museum.

Var. **ungulifera,** new. A male specimen from Corozal, Panama, differs in having the spur of the hind tibia long, very slender and curved, measuring as long as the third tarsal joint. The scutellum is reddish and the prescutellar spot is lacking. The veins are light yellow and not coarse.

Var. **nigrocalcarata,** new. A male specimen from Alhajuelo, Panama, differs in having the spur of the hind tibia very large and broad and black, so it contrasts markedly with the remainder of the legs. The prescutellar spot is lacking but the scutellum is blackish like the metanotum and abdomen. The upper occipital orbits are polished and the veins are only moderately brown. The wings of both variations are less than three times as long as broad. Possibly these specimens represent distinct species. They are deposited in the U. S. National Museum.

Elaphropeza luteicollis, sp. nov.

Length 1.5 mm. Slender, the head and abdomen black, thorax reddish, legs yellow, apex of the tibiæ black, hairs and bristles yellow. Front narrow, its sides slightly converging below, at the bottom one-fourth as wide as the second antennal joint, eyes separated by a line beneath the antennæ; palpi white, proboscis short, brown; antennæ horizontal, yellow, no seta beneath, the third joint lanceolate, one-half longer than wide, the arista two and six-tenths times as long as the antennæ, its pubescence close and short. Thorax reddish yellow, the metanotum and rarely the scutellum brown, hairs very sparse, two rows of two acrostichals, only four hairs in the dorsocentral rows. Sides of middle abdominal segment with flattened setulæ; hypopygium black, nearly bare. Hind tibiæ with two extensor bristles trisecting its length, the terminal spur long and sharp. Halteres yellow. Wings clear hyaline, veins narrow, light brown, marginal cell moderately long, the second, third and fourth sections of the costa proportioned 1 : 1.8 : 1, the third and fourth veins straight, uniformly and slightly diverging, the first posterior cell widest at the apex, the anterior cross-vein at the middle of the second basal cell, last two sections of the fourth vein proportioned 1 : 3, of the fifth vein, 1.8 : 1.

Forty specimens, collected by August Busck for the U. S. National Museum in various places in the Canal Zone of Panama.

Elaphropeza nigricans sp. nov.

♂. Length 1.7 mm. Near *tenera* but with longer antennæ, shorter arista and more hairy body. Front narrowly V-shaped, at the bottom one-third as wide as the second antennal joint; ocellar and vertical bristles long and blackish; antennæ black, the second joint without long seta, the third joint lanceolate, twice as long as wide, the terminal arista scarcely longer than the antennæ, short-pubescent; eyes nearly contiguous below the antennæ; palpi white, and with a few white hairs; proboscis short and brown. Thorax polished black, but uniformly covered with long, black hairs, forming four rows of acrostichals with about eight hairs to each row, prescutellar and scutellar pairs of bristles long and black. Abdomen shining black, the sides of the middle segment with many scale-like setulæ; hypopygium minute. Legs yellow, the outer third of hind femora brown, hind tibiæ with two extensor bristles and with a very short and blunt apical spur. Halteres whitish; calypteres with five dusky hairs. Wings clear hyaline, veins narrow but dark, the second, third and fourth sections of the costa proportioned

1.5 : 2 : 1, the third and fourth veins straight, very slightly divergent, the last two sections of the fourth vein proportioned 1 : 2.7, of the fifth vein, 2.5 : 1, hairs of hind margin short.

One specimen: Corazal, Canal Zone, Panama, March. Collected by August Busck for the U. S. National Museum.

Elaphropeza pleuralis, sp. nov.

Length 2 mm. Robust, yellow species marked with black, hairs and bristles yellow. Occiput polished black, the occipital bristles longer than the ocellar; front very narrow, its sides converging below, at the bottom one-fourth as wide as the second antennal joint, eyes almost contiguous below the antennæ; palpi pale yellow and with a few yellow hairs, proboscis luteous; antennæ horizontal, pale yellow, the second joint with a circle of setulæ but without seta beneath, third joint short-lanceolate, one and one-half times as long as wide, the terminal arista pubescent, two and one-half times as long as the antenna. Thorax luteous, marked with a black, prescutellar spot, which is round in front and includes the scutellum and metanotum behind, a round prealar spot on the mesopleuræ, encroaching on the sternopleura; mesonotal hairs sparse, two rows of four acrostichals, a pair each of prescutellar and scutellar bristles. Abdomen yellow, not chitinized except the black middle segment and the narrow one following, sides of these segments with many flattened black setulæ; last tergite fringed with hairs, hypopygium small, elongate, rather hairy. Legs yellow, the last tarsal joint black, only the middle femora with preapical bristle, spur of the hind tibiæ long, blunt, brown, two extensor bristles on the hind tibiæ, one at the middle and one half-way to the knee. Halteres whitish, calypteres dark, with seven brown cilia. Wings clear hyaline, veins thin and brown, the second, third and fourth sections of the costa proportioned 1.5 : 2.5 : 1, the third and fourth veins parallel, the submarginal cell at the end of the first vein one-half as wide as the marginal and at the end of the second vein equal to the first posterior, last two segments of the fourth vein proportioned 1 : 2.7, of the fifth vein, 2.5 : 1, marginal cilia short.

Four specimens: Alhajuelo, Panama, and Orizaba, Vera Cruz; from the U. S. National Museum.

Elaphropeza plumea, sp. nov.

♀. Length 2.2 mm. Robust shining yellow species with black occiput and heavily pubescent arista, discal cell large. Front very narrow, almost linear, shining black, face linear and black, occiput finely gray pollinose, cheeks and proboscis yellow, palpi large and white, epistome white pollinose; vertical bristles black; antennæ yellow, the second joint with uniform setulæ, the third joint ovate, one-half longer than broad, the blackish arista including its dense hairs appearing as thick as one-half the diameter of the third joint. Thoracic hairs moderately dense, the bristles yellowish; tip of the scutellum, center of the metanotum and a prescutellar spot brown. Middle segment of the abdomen brown and with flattened lateral setulæ. Legs slender, flexor hairs of the front femora long and yellow, middle tibiæ armed within with two rows of minute hook-like black setulæ, the apex angulate and black, hind tibiæ with two extensor bristles located before the basal third and beyond the apical third, the apical lappet sharp and rather strong. Halteres yellow. Wings narrow, more than three times as long as wide, veins yellow, second, third and fourth sections of the costa proportioned 1 : 1.3 : 0.6, third and fourth veins nearly straight and parallel, sections of the fourth vein proportioned 1 : 1 : 2.2, of the fifth vein, 2.5 : 1.

One specimen: Orizaba, Mexico (H. H. Smith); in author's collection.

Elaphropeza rectineura, sp. nov.

Length 1.6 mm. Robust, yellow species, with pale hairs and bristles, last tarsal joint blackish. Head black, front narrow, the sides slightly converging below, at the bottom one-third as wide as the second antennal joint, ocellar bristles long, eyes contiguous beneath the antennæ; palpi white, proboscis short, yellow; antennæ yellow, the second joint without seta, the third joint broadly lanceolate, scarcely twice as long as broad. Thorax loosely hairy, two rows of six acrostichals, scutellum yellow, with lateral bristle one-fourth as long as the apical pair, metathorax yellow. Abdomen brownish yellow in the middle segments, where laterally there are many minute flattened setulæ. Middle femora alone with preapical setulæ, hind tibiæ with two long extensor bristles trisecting its length, the apical spur short and blunt. Halteres yellow, calypteres with five cilia. Wings clear hyaline, rather broad and rounded, marginal cilia short, the second, third and fourth sections of the costa proportioned 1 : 2 : 1, the third and fourth veins nearly straight, uniformly but slightly diverging, the first posterior cell widest at its apex, anterior cross-vein before the middle of the second basal cell, the outer two sections of the fourth vein proportioned 1 : 2.7, of the fifth vein, 2 : 1.

Two specimens: Tabogal and Corazal, Panama, collected by August Busck for the U. S. National Museum.

Elaphropeza seminigra, sp. nov.

♂. Length 2.5 mm. Partly testaceous yellow and partly black. Occiput black, the upper orbits largely shining, the remainder pollinose, ocellar bristles brown, reaching to the antennæ, vertical bristles long and black; front very narrowly triangular; antennæ yellow, the third joint but slightly longer than deep, its blackish arista three times the length of the antenna proper, closely and evidently pubescent; palpi yellow, proboscis tipped with black. Thorax shining, the mesonotum broadly yellow about the shoulders, medially black, the dark coloring extending from side to side at the wings, bristles and hairs long and yellow, four rows of scattered acrostichals; scutellum and metanotum black, the apical pair of scutellar bristles approximate, long and cruciate;

pleuræ irregularly marked with black and reddish yellow, the mesopleuræ blackened except toward the coxæ. Abdomen yellowish, the middle and apical segments black, scales of the middle segment prominent on a gray velvety setting, abdominal hairs yellow. Legs yellow, the tarsi becoming dusky at the apex, front legs devoid of setulæ, middle femora and tibiæ with close-set rows of black setulæ, anterior femora with a long basal, yellow bristle underneath, hind tibiæ with a single black extensor bristle at two-fifths its length, the apical spur blackened, curved and pointed. Halteres pale yellow. Wings yellowish hyaline, their roots yellow, veins brown, costal sections proportioned 4 : 1.5 : 2.5 : 1, third and fourth veins parallel toward the end, anterior cross-vein at middle of the second basal cell, posterior cross-vein at the middle of the wing, sections of the fifth vein 2 : 1, costal hairs conspicuous.

Two specimens: San Jose, Costa Rica, March, 1915, received from Dr. A. H. Sturtevant.

Elaphropeza simplicipes, sp. nov.

Length 1.5 mm. Yellow, head cinereous black, scutellum, metanotum, middle segment of the abdomen and a vague prescutellar spot blackish, antennæ, mouthparts and legs yellow, middle tibiæ of the male with microscopic denticles within, of the female without denticles. Front narrow, shining, its sides nearly parallel, face linear, white-pollinose, vertical bristles brownish, third antennal joint conical, one-half longer than broad, the arista microscopically pubescent, about two and one-third times the antennal length. Mesonotum with sparse hairs, its bristles yellow; lateral setulæ of the middle segment of the abdomen flattened; upper valve of the brownish pygidium rounded and sericeous, the apical fringes short. Legs rather slender and short, front femora without black setæ, the two extensor bristles of the hind tibiæ close together, the apical spur moderate, yellowish, velvety and rather acute, last tarsal joint not dark. Wings less than three times as long as broad, veins yellow and thin, second, third and fourth sections of the costa proportioned 1 : 1.7 : 1, third and fourth veins straight and slightly diverging, sections of the fourth vein proportioned 1 : 1 : 2.2, of the fifth vein, 1 : 0.4.

Montego Bay and Balaklava, Jamaica. Type in the Boston Society of Natural History.

A male specimen from Victoria, Texas, in the U. S. National Museum, is associated here. It is larger, measuring two millimeters, has the outer antennal joint dark, the metanotum reddish and the last tarsal joint dusky. Although phyletically it probably represents a distinct species the visible differences are too slight to utilize.

Elaphropeza tenera, sp. nov.

Length 1.5 mm. Polished black of a brownish tinge, hairs very sparse and pale. Front narrow, the sides nearly parallel, at the bottom less than one-half the width of the second antennal joint; ocelli minute, the ocellar bristles long; eyes nearly touching below the antennæ; palpi broad, white, with a couple of white bristles, proboscis yellow; antennæ short, yellow, the last joint short-lanceolate, one and one-half times as long as wide, the arista three times the antennal length, microscopically pubescent. Hairs of middle abdominal segment strong, but not scale-like in the Trinidad specimen; hypopygium small. Legs including the coxæ pale yellow, slender, the front trochanters with a black dot, apex of hind tibiæ blackish in the Trinidad specimen, middle femora alone with preapical bristle, hind tibiæ with two extensor bristles, the outer one small, the apical spur long and thumb-like. Halteres whitish; calypteres with four pale cilia. Wings clear hyaline, veins pale, the third section of the costa one and one-half times either the second or fourth section, the third and fourth veins straight, slightly diverging, the last two sections of the fourth vein proportioned 1 : 1, of the fifth vein, 2 : 1, wing margin ciliate.

Two specimens. Porto Bello, Panama, March 13, 1911, in the collection of the U. S. National Museum, and Montserrat, Trinidad Island, June 29, both collected by August Busck.

Elaphropeza uniseta, sp. nov.

♀. Occiput black, lightly pollinose, a spot on each side of the vertex shining, ocellar and vertical bristles short and black; front very narrow, linear, eyes subcontiguous beneath the antennæ; palpi and proboscis yellow, the palpi with scattered blackish hairs; antennæ horizontal, brown, the third joint triangular, twice as long as deep, the blackish arista slender, microscopically and closely pubescent, twice as long as the antennæ. Thorax shining reddish yellow, mesonotum with a median vitta abbreviated behind, and with a spot above the notopleural suture dark brown, center of the scutellum and the inflated sides of the first abdominal segment also brown; abdomen weakly chitinized except the middle segment whose sides are thickly studded with black scale-like setulæ; hairs of the thorax fine, dark, confined to the anterior region, comprising a few posthumeral and four definite rows of acrostichals with about five hairs to each row; presutural dorsocentral long, scutellum with two long cruciate bristles. Legs including the coxæ yellow, a little dusky distally, anterior femora with basal hair below, middle femora with a strong preapical bristle, hind tibiæ with a single strong extensor bristle located below the middle and with a broad blunt apical spur. Knob of halteres blackish; calypteres small but with a fan-like fringe of dark cilia. Wings hyaline, veins yellow, first vein ending beyond the middle, third section of the costa about three times either the second or the fourth section, marginal cell at the end of the first vein nearly twice as wide as the submarginal, the latter at the end of the second vein as wide as the first posterior cell, third vein lightly sinuous, converging with the fourth on its outer portion, anterior cross-vein before the middle of the second basal cell, the outer two sections of the fourth vein proportioned 1 :2, of the fifth vein, 3 : 1, costa with a basal hair, but not long ciliate, hairs of the posterior margin of the wings very short.

One specimen: Manila, Philippine Islands, Robert Brown, collector, in the U. S. National Museum.

Elaphropeza upsilon, sp. nov.

♂. Length 1.5 mm. Largely yellow with yellow legs and antennæ, the posterior part of the mesonotum marked with a broad U-shaped mark, hind tibiæ with a single extensor bristle located just before its middle, middle tibiæ microscopically denticulate along the flexor side. Head black, occiput pollinose up to the eyes, face linear, white-pollinose; mouthparts yellow; third antennal joint short-ovate, the arista less than three times as long as the antennæ and microscopically pubescent; vertical and ocellar bristles yellow. Hairs of the mesonotum rather sparse and long, bristles yellow; the black mark fills the posterior half of the mesonotum except in the middle and except the postalar callus; scutellum, metanotum and middle segment of the abdomen black, the middle segment of the abdomen with scale-like setulæ along the sides; pygidium brown, glabrous except the marginal fringe. Hind tibiæ with a moderate, acute, yellow, velvety, terminal lappet. Veins brown, second and third sections of the costa nearly equal, third and fourth veins nearly parallel, sections of the fourth vein proportioned 1 : 1 : 2.2, of the fifth vein, 1 : 0.4.

Jamaica (Brues). In author's collection.

Elaphropeza vittata, sp. nov.

♀. Length 1.8 mm. Robust, yellow marked with black. Occiput black, lightly pollinose, its bristles and the ocellars pronounced; front linear, its sides parallel, eyes separated below the antennæ by a dense row of microscopic white hairs; palpi white and with white hairs, proboscis yellow; antennæ destroyed. Thorax polished reddish yellow, marked with a black vitta which is broadest behind and there includes the scutellum and metanotum and meets a black pleural vitta. The median vitta is not sharply bounded, the pleural vittæ fill the meso- and meta-pleuræ. The thoracic hairs are rather long and isolated, two rows of six acrostichal hairs, a pair each of prescutellar and scutellar bristles. Abdomen pale yellow, only the middle segment fully chitinized, the basal segments with only small lateral sclerites, the sides of the middle segment with many glistening scale-like setulæ. Legs yellow, the anterior tibiæ and all of the tarsi a little brownish, anterior femora with a moderate preapical bristle, hind tibiæ with two strong extensor bristles trisecting their length, their terminal spur long and sharpened, pale brown. Halteres white; calypteres ciliate with five brown hairs. Wings clear hyaline, veins yellow, third section of the costa nearly twice as long as the second or fourth, third and fourth veins parallel at the end, anterior cross-vein before the middle of the second basal cell, outer sections of the fourth vein proportioned 1 : 2.5, of the fifth vein, 3 : 1, hind margin with short cilia.

Type specimen from the U. S. National Museum, labeled "on pineapple," Lemon City, Florida, April 12, 1899. A defective specimen from Havana, Cuba, (Dr. A. H. Sturtevant), is apparently the same, differing in that the pleural blackening is less pronounced.

Bibliographic List of the Species of *Drapetis*.

A. Subgenus *Drapetis* Meigen, sens. str.

aliternigra, new name..North America
nigra Melander, not Meigen, Tr. Am. Ent. Soc. xxviii. 208, f. 12, 17, 24 (1902). Lundbeck, Dipt. Dan. iii. 257, note (1910).

assimilis Fallen..Europe
Fallen, Dipt. Suec. Emp. 8, 4, 34, (1815) *Tachydromia;* Walker, Ins. Brit. 136, (1851); Schiner, F. A. i. 95 (1862); Lundbeck, Dipt. Dan. iii. 256, f. 115 (1910); Wahlgren, Ent. Tidskr. xxxi. 87 (1910). Frey, Acta Soc. Fenn. xxxvii. (3) 71 f. 19 (1913).
affinis Loew, N. Beitr. vi. 41. (1859).
arcuata Loew, N. Beitr. vi. 40, (1859); Schiner, F. A. i. 96 (1862); Wahlgren, Ent. Tidskr. xxxi. 87 (1910); Kuntze, Deut. Ent. Zts. 548 (1913).
minima Meigen, not Zetterstedt, B. S. vii. 100 (1838).
nigra Meigen, S. B. vi. 344 (1830); Curtis, Brit. Ent. viii. 397 (1832); Macquart, Suit. a Buff. i. 358 (1834); Walker, List, iii. 511 (1849) occ. in Canada; Walker, Ins. Brit. i. 136 (1851).
pygmæa Roser, Wurttemb. Correspbl. i. 54 (1840).

bispina, new species..Indiana

brevior Brunetti..India
Brunetti, Rec. Ind. Mus. ix. 37 (1913).

decolorata Meunier..Baltic Amber
Meunier, Ann. Sci. Nat. Zool. vii. 95 (1908).

distans Bezzi..N. Guinea
Bezzi, Wien. Ent. Ztg. xxiii. 144 (1904); Ann. Mus. Hung. x. 480 (1912).
divergens Bezzi, not Loew, Ann. Mus. Nat. Hung. ii. 353 (1904).

divergens Loew, not Bezzi..Southern U. S., Antilles
Loew, not Bezzi, Berl. Ent. Zeitschr. xvi. 90, Cent. x. 62 (1872); Melander, Tr. Am. Ent. Soc. xxviii. 210. f. 15 (1902); Bezzi, N. Act. Kais. Akad. xci. 397 (1909).
minuta Williston, Tr. Ent. Soc. Lond. iii. 442. f. 168 (1896); Melander, Tr. Am. Ent. Soc. xxviii. 210 (1902).

diversa, new species..New Mexico

dividua Melander..W. North America
Melander, Trans. Am. Ent. Soc. xxviii. 208, pl. 5. f. 16, 18, 23 (1902).
nigripes Melander, Tr. Am. Ent. Soc. xxviii. 339 (1902) *Stilpon.*

exilis Meigen..Europe
Meigen, S. B. iii. 91, pl. 23, f. 25–28 (1822); Serville and St. Fargeau, Encycl. Meth. x. 437 (1825); Macquart, Dipt. Nord. Fr. iii. 88, part, pl. 2. f. 2 (1827); Meigen, S. B. vi. 344 (1830); Curtis, Brit. Ent. viii. 397, part, (1832); Macquart, Buff. i. 357, part, pl. 8, f. 12a (1834); Zetterstedt, Lapp. 554 (1838); Loew, Progr. Posen (1840) 23. Isis, vii. 552 (1840); Zetterstedt, Dipt. Sc. i. 328 (1842); Boitard, Nouv. Man. iii. 325 (1843); Walker, List, iii. 511, part (1849); Zetterstedt, Dipt. Sc. viii. 3012 (1849); Scholz, Zts. Ent. Bresl. v. (19) 60 (1851); Walker, Ins. Brit. Dipt. i. 136 (1851); Loew, N. Beitr. vi. 42 (1859); Schiner, F. A. Dipt. i. 95 (1862); Lundbeck, Dipt. Dan. iii. 258, f. 116 (1910).

fascifemorata Brunetti..Formosa
Brunetti, Rec. Ind. Mus. ix. 38 (1913).

femorata, new name..Formosa
femoralis Bezzi, not Wheeler and Melander, Ann. Mus. Hung. x. 480 and 483 (1912).

flavicornis, new species..Panama

flavipes MACQUART, not WILLISTON.................................Europe
MACQUART, Suit. a Buff. i. 357 (1834); MEIGEN, S. B. vii. 100 (1838); BOITARD, Nouv. Man. iii. 325 (1843); LOEW, N. Beitr. vi. 38 (1859); SCHINER F. A. i. 95 (1862); STROBL, Mitth. Steierm. xxix. 108 (1892); BEZZI, Arch. Zool. Experim. Gen. (5) viii. 50 (1911).
? *ambigua* MACQUART, Dipt. France iii. 94 (1827) *Platypalpus;* Suit. Hist. Nat. i. 351 (1834); SCHINER, F. A. i. 92 (1862).
? *curvipes* MEIGEN, Syst. Bes. iii. 75 (1822) *Tachydromia.*
exilis MACQUART, part Dipt. France iii. 88 (1827).
fascipes ROSER, Wurttemb. Correspbl. i. 54 (1840).
nigra FALLEN, Dipt. Suec. Emp. 8 (1815) *Tachydromia;* SCHINER, F. A. Dipt. i. 90 (1862) *Platypalpus.*

infumata, new species.................................British Columbia

latipennis MELANDER.................................Kansas, Wisconsin
MELANDER, Tr. Am. Ent. Soc. xxviii. 209, pl. 5, f. 11, 19 (1902).

micropyga, new species.................................W. United States

mortua MEUNIER.................................Baltic Amber
MEUNIER, Ann. Sci. Nat. Zool. vii, 97 (1908).

naica, new species.................................W. United States

nigripes ZETTERSTEDT.................................N. Europe
ZETTERSTEDT, Dipt. Scand. xiii. 1997 (1859); WAHLGREN, Ent. Tidskr. xxxi. 87 (1910).

pilosa, new species.................................C. United States

pusilla LOEW.................................Canary Islands, C. & N. Europe
LOEW, N. Beitr. vi. 36 (1859); SCHINER, F. A. i. 96 (1862); BECKER, Mitth. Zool. Mus. Berl. iv. 42 (1908); STROBL, Verh. Ges. Wien. lix. 179 (1909); LUNDBECK, Dipt. Dan. iii. 259, f. 117 (1910); DAHL, Fauna Chorin. 465 (1912) Desc.; FREY Acta Soc. Fenn. xxxvii (3) 71 (1913) occ.
exilis ZETTERSTEDT, (not MEIGEN), Ins. Lapp. 554, 1, part (1838); Dipt. Scand. i. 328 (1842); viii. 3012 (1849).
minima ZETTERSTEDT, not MEIGEN, Dipt. Scand. i. 327, 1. (1842).

var. **fumipennis** STROBL.................................Spain
STROBL, Mem. r. Soc. esp. N. H. iii. 312 (1906).

rotundicornis BRUNETTI.................................India
BRUNETTI, Rec. Ind. Mus. ix. 38 (1913).

rufipes BRUNETTI.................................Bengal
BRUNETTI, Rec. Ind. Mus. ix. 38 (1913).

setulosa, new species.................................W. North America

trichura, new species.................................Texas

xanthopyga BEZZI.................................N. Guinea
BEZZI, Ann. Mus. Nat. Hung. ii. 352. 33 (1904); x. 479 and 485 (1912).

B. Subgenus *Eudrapetis*, new subgenus.

ænea WALKER.................................Egypt
WALKER, Entom. v. 273. 45 (1871).

ænescens WIEDEMANN.................................Europe, Africa
WIEDEMANN, Ausser. zweifl. Ins. ii. 649 (1830); LOEW, N. Beitr. vi. 35. (1859); Dipterenf. Südafr. 270 (1860); SCHINER, F. A. i. 96 (1862); GIGLIO-TOS, Ann. Soc. Ent. Fr. lxiv. 359 (1895); BECKER, Mitth. Zool. Mus. Berl. ii. 40 (1902); STROBL, Glasnik Zem. Mus. Bosn. Herceg. xiv. 470 (1902); Mitth. Bosn. Herceg. ix. 528 (1904); BEZZI, Ann. Mus. Nat. Hung. ii. 351 (1904); BECKER, Zts. Hym. Dipt. vii. 119 (1907); BEZZI, Ann. Mus. Hung. x. 479, 482 (1912); Suppl. Entom. iii. 75 (1914); MEIJERE, Tijd. Ent. lvii. suppl. 75 (1914).
brunnipes MACQUART, Suit. a Buff. i. 358. (1834); MEIGEN, S. B. vii. 101. 6 (1838); LOEW, Progr. Posen (1840) 23; Isis vii. 552 (1840); BOITARD, Nouv. Man. iii. 325 (1843); SCHOLZ, Zts. Ent. Bresl. v. (19) 60 (1851).
crassa LOEW, Ofvers. af k. Vet. Akad. Forhandl. xv. 341. 2 (1858).

armata, new species...United States

armipes Bezzi..Chile
Bezzi, N. Acta Kais. Akad. xci 398, f. 18 (1909).

aterrima Curtis...England
Curtis, Brit. Ent. 397 (1834); Walker, Ins. Brit. i. 136 (1851); Loew, N. Beitr. vi. 40, note (1859); Lundbeck, Dipt. Dan. iii. 254, f. 111-113 (1910); Frey, Acta Soc. Fenn. xxxvii (3) 68 (1913).
atra Walker, Ins. Brit. i. pl. 5, f. 3. (1851) no description.
nervosa Loew, N. Beitr. vi. 37, (1859); Schiner, F. A. Dipt. i. 96 (1862).
nigritella Zetterstedt...C. & N. Europe
Zetterstedt, Dipt. Scand. i. 298 (1842) *Tachydromia*.

brevis Bezzi...Formosa
Bezzi, Ann. Mus. Hung. x. 480 and 483 (1912).

brevis Meunier...Baltic Amber
Meunier, Ann. Soc. Sci. Nat. Zool. vii, 96 (1908).

decorata Meunier..Baltic Amber
Meunier, Ann. Sci. Nat. Zool. vii, 96 (1908).

discalis, new species.................................Washington, California

diversipes, new species...California

dorsiseta, new species..Costa Rica

facialis, new species...Georgia, Alberta

femoralis Wheeler & Melander...........................Vera Cruz, Tabasco
Wheeler and Melander, Biol. C. Am. Dipt. i. 376 (1901); Melander, Trans. Am. Ent. Soc. xxviii. 211, f. 13 (1902); Bezzi, N. Act. Kais. Akad. xci. 398 (1909).

fortis Bezzi...Peru
Bezzi, N. Acta Kais. Akad. xci. 399 (1909).

gilvipes Loew..Texas, West Indies
Loew, Berl. Ent. Zeitschr. xvi. 89: Cent. x. 61 (1872); Melander, Tr. Am. Ent. Soc. xxviii. 213, 340 (1902); Bezzi, N. Act. Kais. Akad. xci. 397 (1909).

humilis Frey..Finland
Frey, Acta Soc. Fenn. xxxvii (3) 69, f. 16 18 (1913).

inculta Coquillett...Texas, California
Coquillett, Proc. U. S. Mus. xviii, 439 (1896) *Platypalpus*.
Melander, Tr. Am. Ent. Soc. xxviii, 218 (1902).

inermis, new species...Panama

lata Coquillett..Florida
Coquillett, Proc. Ent. Soc. Wash. v. 266 (1903) *Tachydromia;* Melander, Psyche, xvii, 51 (1910).

Loewi Dahl..Germany
Dahl, Fauna Chorin, 465 (1912).

luteipes St. Fargeau and Serville..France
St. Fargeau and Serville, Encycl. Method. x. 437 (1825).

marginata Meigen..E. Europe
Meigen, Syst. Bes. vii. 100 (1838).

medetera Melander...W. United States
Melander, Trans. Am. Ent. Soc. xxviii. 208. pl. v. f. 22 (1902); Coquillett, Proc. Ent. Soc. Wash. v. 265 (1903) *Elaphropeza;* Melander, Ent. News, xvii, 372 (1906); Bezzi, Ann. Mus. Nat. Hung. v. 567 (1907) *Elaphropeza*.

moriella Zetterstedt..N. and C. Europe

Zetterstedt, Ins. Lapp. 552 (1838) *Tachydromia;* Dipt. Sc. i. 299 (1842) *Tachydromia;* Wahlgren, Ent. Tidskr. xxxi. 86, f. 15 (1910).

curvinervis Zetterstedt, Dipt. Sc. i. 301 (1842) *Tachydromia.*

flexuosa Loew, Progr. Posen, 1840, 23; Isis vii. 552 (1840); Scholz, Zts. Ent. Bresl. v. (19) 60 (1851); Loew Neue Beitr. vi. 39 (1859); Schiner, F. A. Dipt. i. 96 (1862).

geniculata Fallen, Empid. 7, part (1815) *Tachydromia.*

nigra Zetterstedt, Dipt. Sc. i. 297 (1842) *Tachydromia;* Bonsdorf, Finl. iv. Ins. i. 150 (1861) *Tachydromia.*

picipes Zetterstedt, Dipt. Sc. i. 298 (1842) *Tachydromia.*

var. **setigera** Loew •

Loew, Neue Beitr. vi. 39 (1859); Schiner, F. A. Dipt. i. 96 (1862); Lundbeck, Dipt. Dan. iii. 255, f. 114 (1910); Frey, Acta Soc. Fenn. xxxvii (3) 70 (1913).

var. **dilutipes** Strobl..Spain

Strobl, Mem. Soc. Esp. Hist. Nat. iii. 312 (1906).

nitens, new species..Mexico, Panama

nuda, new species..Africa

obscuripennis Philippi, not Bezzi..Chile

Philippi, Verh. z. b. Ges. Wien. xv. 768 (1865); Bezzi, N. Act. Kais. Akad. xci. 397 (1909).

œdimera, new species..Vera Cruz

parvicornis, new species..Washington

pennescens, new species..Peru

phæoptera Bezzi..N. Guinea

Bezzi, Wien. Ent. Ztg. xxiii. 145 (1904); Ann. Mus. Hung. x. 479 (1912).

obscuripennis Bezzi, not Philippi, Ann. Mus. Nat. Hung. ii. 351 (1904).

pilipes Loew..S. Europe, N. Africa

Loew, N. Beitr. vi. 36 (1859); Bezzi, Bull. Soc. Ent. Ital. xxx. 152 (1899); Becker, Mittl. Zool. Mus. Berl. ii. 40 (1902).

plumipes, new species..Texas

pubicornis Bezzi..Formosa

Bezzi, Ann. Mus. Hung. x. 479 and 482 (1912).

quadrisetosa, new species..Mexico, Central America

scissa, new species..W. United States

medetera Melander, part, Tr. Am. Ent. Soc. xxviii. 208, pl. 5, f. 22 (1902); Coquillett Proc. Ent. Soc. Wash. v. 265 (1903) *Elaphropeza*; Melander, Ent. News, 372 (1906); Bezzi, Ann. Mus. Hung. v. 567 (1907) *Elaphropeza.*

septentrionalis Melander..Michigan

Melander, Tr. Am. Ent. Soc. xxviii. 211 (1902).

var. **mexicana**, new variety..Tampico

spectabilis Melander..United States

Melander, Tr. Am. Ent. Soc. xxviii. 212, f. 9, 20 (1902).

spinipes, new species..Africa

unipila Loew..W. United States

Loew, Berl. Ent. Zeitschr. xvi. 88, Cent. x. 60 (1872); Melander, Tr. Am. Ent. Soc. xxviii. 211 and 339, f. 10, 14, 21 (1902); Ent. News, xvii. 372 (1906).

var. **nitida** Melander..W. United States

Melander, Tr. Am. Ent. Soc. xxviii. 207, f. 10, 14, 21, and 339; Cole, Rept. Laguna Marine Lab. i. 152 (1912).

vitiosum Meunier..Baltic Amber

Meunier, Ann. Sci. Nat. Zool. 7, 96, pl. iii. f. 10–13 (1908)

xanthopoda Williston part..West Indies

Williston, Tr. Ent. Soc. Lond. iii. 308, pl. iv. f. 85, part (1896); Melander, Tr. Am. Ent. Soc. xxviii, 212 and 340 (1902).

flavipes Williston, not Macquart, Tr. Ent. Soc. Lond. iii. Appendix. 141. table (1896); Melander, Tr. Am. Ent. Soc. xxviii. 212 (1902).

C. Subgenus *Ctenodrapetis* Bezzi.

aristalis, new species.......................................Philippine Islands

ciliatocosta BEZZI.......................................Australia, South America
BEZZI, Ann. Mus. Nat. Hung. ii. 355, f. 6 (1904); N. Act. Kais. Akad. xci. 397 and 400 (1909); Ann. Mus. Hung. x. 481 (1912).

cuneipennis, new species.......................................Philippine Islands

discoidalis BEZZI.......................................E. Indies
BEZZI, Ann. Mus. Nat. Hung. ii. 355 (1904); x. 482 (1912).

gracilis BEZZI.......................................N. Guinea
BEZZI, Ann. Mus. Nat. Hung. ii. 354 (1904); x. 480 (1912).

hamifera BEZZI.......................................Formosa
BEZZI, Ann. Mus. Hung. x. 479 and 485 (1912).

monochæta BEZZI.......................................Peru
BEZZI, N. Acta. Kais. Akad. xci. 401 (1909).

rubrithorax BEZZI.......................................N. Guinea
BEZZI, Ann. Mus. Nat. Hung. ii. 356 (1904); x. 482 (1912).

strigifera MEIJERE.......................................Java
MEIJERE, Tijdschr. Ent. Liv. 333 (1911); lvi. suppl. 75 (1914).

valdiviana PHILIPPI.......................................Chile
PHILIPPI, Verh. Ges. Wien. xv. 768 (1865) *Drapetis;* BEZZI, N. Act. Kais. Akad. xci. 397 (1909) ?*Ctenodrapetis.*

D. Subgenus *Elaphropeza* Macquart.

abdominalis WIEDEMANN.......................................China
WIEDEMANN, Aussereurop. Ins. ii. 12 (1830) *Tachydromia:* BEZZI, Ann. Mus. Hung. ii. 359, note (1904) *Tachydromia;* MELANDER, Psyche, xvii. 52 (1910) *Ctenodrapetis.*

antennata BECKER.......................................E. Africa
BECKER, Bul. Mus. Paris 115 (1909); Ann. Soc. Ent. Fr. lxxix. 24 (1910); BEZZI, Ann. Mus. Hung. x. 481 (1912).

Bacis WALKER.......................................Jamaica
WALKER, List. Dipt. Ins. iii. 510 (1849) *Platypalpus;* Coquillett, Proc. U. S. Mus. xviii. 439 (1896) *Tachydromia;* MELANDER, Tr. Am. Ent. Soc. xxviii. 226 (1902) *Tachydromia;* BEZZI, Ann. Mus. Hung. iii. 460 (1905) *Tachypeza;* N. Act. Kais. Akad. xci. 402, note (1909); MELANDER, Psyche, xvii. 52 (1910) *Ctenodrapetis.*

basalis BEZZI.......................................Ceylon
BEZZI, Ann. Mus. Hung. ii. 349 (1904); v. 567 (1907); x. 479 (1912).

bicolor BEZZI.......................................N. S. Wales
BEZZI, Ann. Mus. Hung. ii. 349 (1904); v. 567 (1907); x. 482 (1912).

bicoloripes BRUNETTI.......................................E. Himalayas
BRUNETTI, Rec. Ind. Mus. ix. 43 (1913).

bihamata BEZZI.......................................N. Guinea
BEZZI, Ann. Mus. Nat. Hung. ii. 353 (1904) *Drapetis.*

binotata MEIJERE.......................................Java
MEIJERE, Tijdschr. Ent. Liv. 333 (1911) *Drapetis;* lvi. suppl. 75 (1914).

calcarifera BEZZI.......................................Formosa
BEZZI, Ann. Mus. Hung. v. 267 and 268 (1907); x. 481 and 488 (1912).

callositibia BEZZI.......................................N. Guinea
BEZZI, Ann. Mus. Nat. Hung. ii. 354 (1904) *Drapetis;* x. 480 (1912) *Drapetis.*

calva, new species.......................................Panama

comata, new species.......................................Trinidad

dispar Adams .... Rhodesia
Adams, Kans. Univ. Sci. Bul. iii. 157 (1905); Bezzi, Ann. Mus. Hung. v. 567 (1907); x. 480 (1912).

ephippiata Fallen .... Europe
Fallen, Empid. 11 (1815) *Tachydromia;* Meigen, Syst. Bes. iii. 65, pl. 23, f. 10 (1822) *Hemerodromia;* Macquart, Dipt. Nord. Fr. iii. 87, pl. 2, f. 1 (1827); Hist. Nat. i. 359, pl. 8, f. 14a (1834); Zetterstedt, Dipt. Sc. i. 326 (1842); Boitard, Nouv. Man. iii. 325 (1843); Walker, List. iii. 505 (1849); Ins. Saunders. i. 134, pl. 5, f. 4 (1851); Scholz, Zts. Ent. Bresl. v. 60 (1851) (*ephippium*); Schiner, F. A. Dipt. i. 95 (1862); Strobl, Mitth. Steierm. xxix. 127 (1892); Melander, Ent. News, xvii. 372 (1906) *Drapetis;* Bezzi, Ann. Mus. Hung. v. 567 (1907); Lundbeck, Dipt. Dan. iii. 273, f. 123, 124 (1910); Wahlgren, Ent. Tidskr. xxxi. 89 (1910); Bezzi, Ann. Mus. Hung. x. 482 (1912); Frey, Acta Soc. Fenn. xxxvii. (3) 75 (1913).
? *maculata* Macquart, Mem. Soc. Sci. Lille, 153 (1823) *Tachydromia.*

exul Osten Sacken .... Philippine Islands
Osten Sacken, Berl. Zts. xxvi. 113 (1882); Bezzi, Ann. Mus. Hung. ii. 347; (1904); v. 567 (1907); x. 480 (1912) *Drapetis.*

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Becker, Bull. Mus. Paris 116 (1909) *Drapetis;* Ann. Soc. Ent. Fr. lxxix. 24 (1910) *Drapetis;* Bezzi, Ann. Mus. Hung. x. 182 (1913).

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Williston, Trans. Ent. Soc. Lond. iii. 308, pl. 11, f. 86 (1896) *Drapetis;* Coquillett, Proc. U. S. N. Mus. xxii. 251 (1900) *Tachydromia;* Wheeler & Melander, Biol. C. Am. Dipt. i. 376 (1901) *Drapetis;* Melander, Mon. Empid. 213 (1902) *Drapetis;* Coquillett, Proc. Ent. Soc. Wash. v. 265 (1903) *Tachydromia;* Bezzi, N. Act. Kais. Akad. xci. 397 and 398 (1909) *Drapetis;* Melander, Psyche, xvii. 52 (1910) *Ctenodrapetis;* 1910; Bezzi, Ann. Mus. Hung. x. 481 (1912).
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xanthopoda Williston part, Tr. Ent. Soc. Lond. iii. Appendix, 441, table (1896) *Drapetis.*

formosæ Bezzi .... Formosa
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fulvithorax v. d. Wulp .... Ceylon
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inflexa, new species .... Panama

Kerteszi Bezzi .... Formosa
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læta, new species .... Panama
var. **nigrocalcarata,** new var .... Panama
var. **ungulifera,** new var .... Panama

lanuginosa Bezzi .... Formosa
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lutea Meijere .... Java
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luteicollis, new species .... Panama

marginalis BEZZI BEZZI, Ann. Mus. Hung. x. 481 and 489 (1912).	Formosa
melanura BEZZI BEZZI, Ann. Mus. Hung. x. 481 and 489 (1912).	Formosa
metatarsata BEZZI BEZZI, Ann. Mus. Hung. ii. 348 (1904); v. 567 (1907); x. 482 (1912).	Ceylon
nigricans, new species	Panama
obliquinervis MEIJERE MEIJERE, Tijd. Ent. suppl. 73, pl. 2, f. 9 (1914).	Java
palpata MEIJERE MEIJERE, Tijdschr. Ent. liv. 330 (1911); lvi. suppl. 76 (1914).	Java
pictithorax BEZZI BEZZI, Ann. Mus. Hung. x. 482 and 486 (1912).	Formosa
pleuralis, new species	Vera Cruz, Panama
plumea, new species	Mexico
rectineura, new species	Panama
scutellaris BEZZI BEZZI, Ann. Mus. Hung. x. 481, 482, 487 (1912).	Formosa
seminigra, new species	Costa Rica
simplicipes, new species	W. Indies
spuria BEZZI BEZZI, Ann. Mus. Hung. ii. 347 (1904); v. 567 (1907); x. 480 (1912).	N. Guinea
tenera, new species	Trinidad, Panama
uniseta, new species	Philippine Islands
upsilon, new species	W. Indies
variata, new name *variegata* BRUNETTI (bis) Rec. Ind. Mus. ix. 42 (1913).	India
variegata BRUNETTI BRUNETTI, Rec. Ind. Mus. ix. 39 (1913) *Drapetis*.	Burma
vittata, new species	Florida
xanthocephala BEZZI BEZZI, Ann. Mus. Hung. x. 481 and 488 (1912).	Formosa

NYMPHS, NAIADS, AND LARVÆ.

By J. H. Comstock.

"You nymphs, called naiads, of the wand'ring brooks."
—Shakespeare.

The object of this note is to propose an addition to the terminology of the metamorphoses of insects, which I believe will tend to make more clear certain fundamental distinctions now generally recognized.

The older entomologists recognized two types of postembryonic development of insects. These types were distinguished by various terms, but were most commonly described as *incomplete metamorphosis* and *complete metamorphosis*. The term *larva* was applied by these writers to the early stages of all insects, those undergoing an incomplete metamorphosis as well as those in which the metamorphosis is complete.

At a later period, during the last quarter of the last century, it was found desirable to distinguish the early stages of insects with a complete metamorphosis from those of insects with an incomplete metamorphosis; hence the term *larva* was restricted to the young of insects with a complete metamorphosis and the term *nymph*, which had been formerly used as a synonym of pupa, was applied to the young of insects with an incomplete metamorphosis.

In the earlier descriptions of these two types of metamorphosis account was taken only of the difference in degree of the change in the form of the body that distinguishes the two types; in one the change is partial or incomplete, in the other it is complete. The fundamental reason for this difference was not generally appreciated although it was understood by some writers.

Fritz Muller in his "Für Darwin" (1864) points out clearly the essential difference between incomplete metamorphosis and complete metamorphosis and in discussing the latter makes the aphorism, "There were, I believe, perfect insects before larvæ and pupæ." The significance of this aphorism should be clearly understood by every student of entomology, which is far from being the case. This is shown by the fact that frequently writers refer to larval characteristics as being more generalized than the corresponding characteristics of the adult.

The fundamental fact that should be understood is that larvæ, *i. e.*, the young of insects with a complete metamorphosis, exhibit a cenogenetic or sidewise development. Here the form of the body bears but little relation to the form to be assumed by the adult, the nature of the larval life being the controlling factor. While the ontogeny of an orthopterous insect can be taken as an indication of the course of the phylogeny of the race to which it belongs, this obviously is not the case with representatives of the Diptera or the Lepidoptera. In these orders, and in others with a complete metamorphosis, the larvæ have been sidewise developed while the adults have continued their specialization in a direct line. This is an illustration of the fact pointed out by Darwin in his "Origin of Species," that at whatever age a variation first appeared in the parent it tends to reappear at a corresponding age in the offspring.

The more striking of the adaptive characteristics of larvæ are: the form of the body; the internal development of wings; and the retarding of the development of the compound eyes. It is obvious that the restriction of the application of the term larva to the designating of this type of immature insect is a useful one.

Let us now study those immature insects to which the term nymph has been applied, those that were formerly classed as having an incomplete metamorphosis.

It is now quite generally recognized that this group of insects included those exhibiting two quite distinct types of metamorphosis: first, those, as the Orthoptera and Hemiptera for example, in which the development is direct; and second, those in which there is a cenogenetic development. The second group includes the Plecoptera, the Odonata, and the Ephemerida.

In this second group the ontogeny of the individual does not represent the phylogeny of its race. The recognition of this fact has led to the introduction of a term indicating a third type of metamorphosis. We have, therefore, in the more recent textbooks the following categories, in addition to development without metamorphosis, which is characteristic of the Thysanura and Collembola.

First, *gradual metamorphosis* or paurometabolous development. This is characteristic of the Orthoptera, Hemiptera, *et al.*

Second, *incomplete metamorphosis* or hemimetabolous development. This is characteristic of the Plecoptera, Odonata, and Ephemerida.

Third, *complete metamorphosis* or homometabolous development. This is characteristic of the Diptera, Lepidoptera, *et al.*

The features of the cenogenetic development of insects with an incomplete metamorphosis, as the term is now restricted, are very different from those of the cenogenetic development of insects with a complete metamorphosis. In insects with an incomplete metamorphosis the immature stages are modified so as to fit them for aquatic life; the more striking features of larvæ, the elongate form of the body, the internal development of wings, and the retarding of the development of the compound eyes are not exhibited by them.

From this it can be seen that the immature stages of the Plecoptera, the Odonata, and the Ephemerida differ fundamentally from those of insects with a gradual metamorphosis on the one hand and from those of insects with a complete metamorphosis on the other; and that the reasons that make desirable the restriction of the use of the term larva to designate the young of insects with a complete metamorphosis make desirable a distinctive term for the sidewise developed young of those with an incomplete metamorphosis.

I, therefore, propose the restriction of the term *nymph* to the designating of the early stages of insects with a gradual metamorphosis and the use of the term *naiad* for designating the immature stages of the Plecoptera, Odonata, and Ephemerida.

If this proposal is adopted the three terms, nymph, naiad, and larva will each indicate a distinct type of immature insect; and their use will tend to emphasize the distinctive characteristics of the three types of metamorphosis.